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# WAR MACHINE

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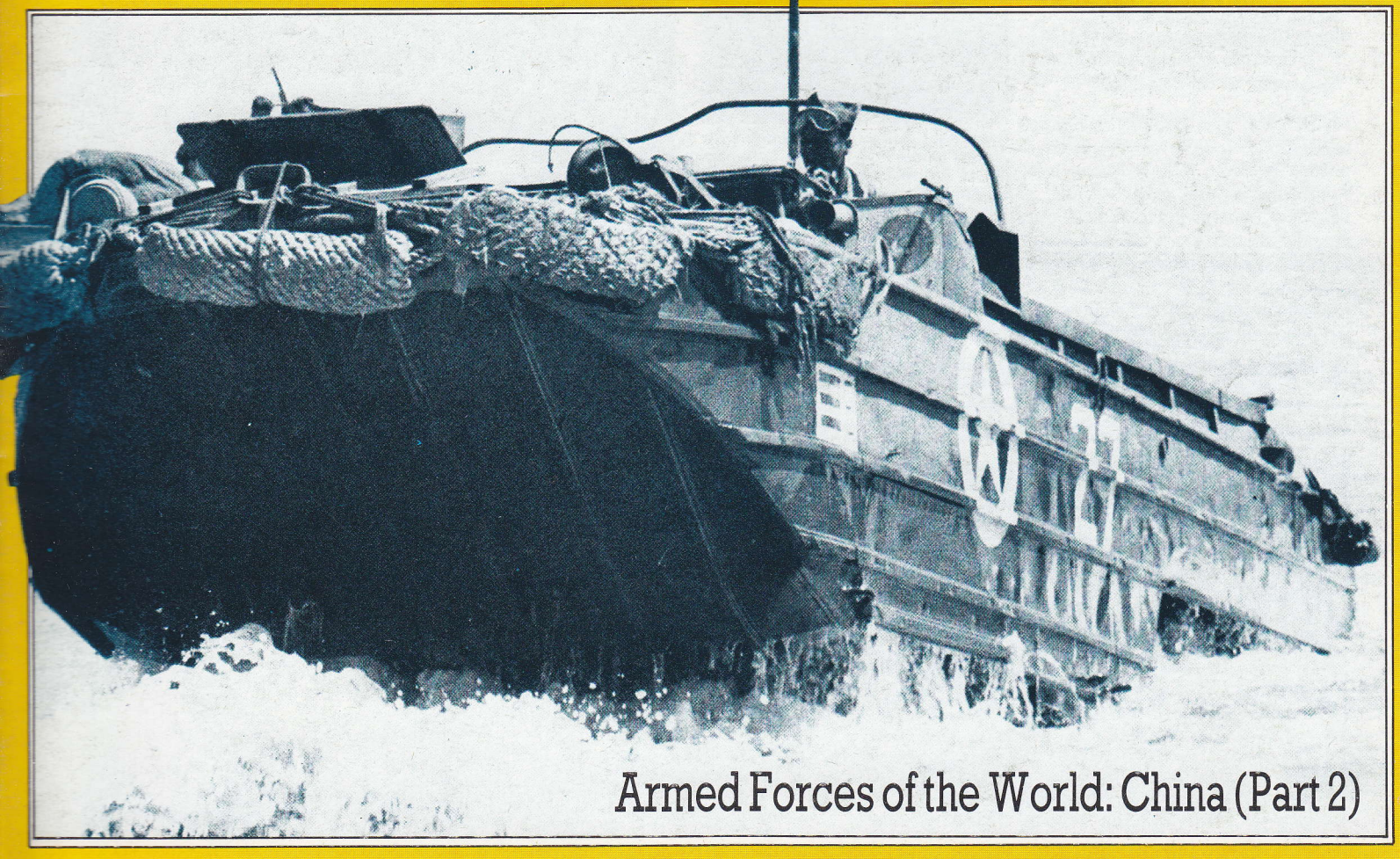

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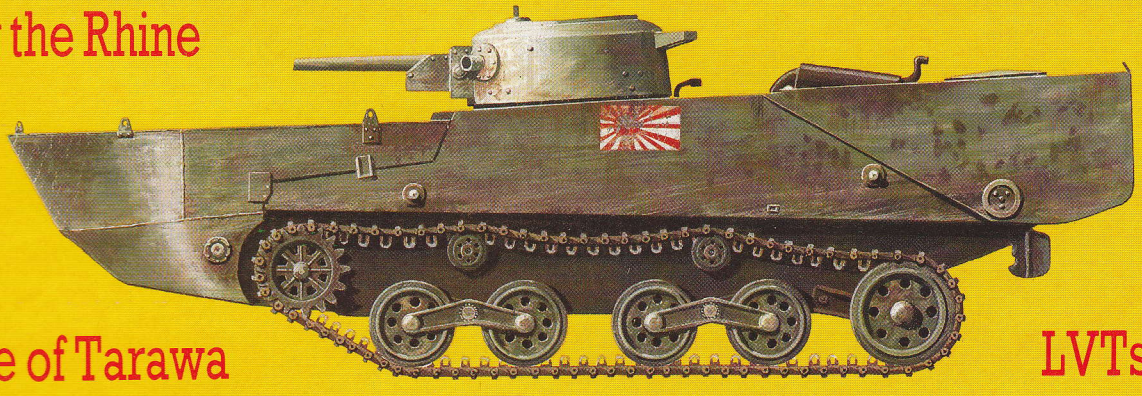

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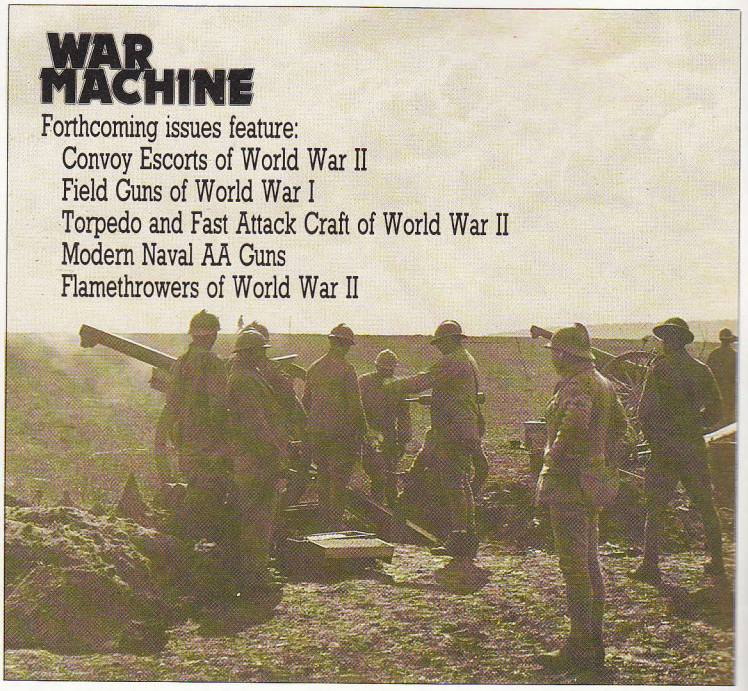


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# Amphibious Vehicles of World War II

***Most of the Great Powers used amphibious vehicles during World War II. Some, like the Soviets' pre-war amphibious light tanks, proved to be superfluous but others, like the DD Shermans and the DUKW, were of crucial importance.***

*A DUKW surges ashore over a landing beach with its trim vane still in the raised position. The rope fenders were to prevent the DUKW banging into a ship's side during the loading operation. DUKWs were used extensively during nearly all Allied amphibious operations from 1943 onwards.*

The range of vehicles contained in this study is much wider than usual, for the range of amphibious vehicles used during World War II was very large. At the lower end of the range was the little German Schwimmwagen, while at the upper end the German LWS took some beating for sheer size, even if the slab-sided American LVTs were far more numerous. This wide range was a result of the many and various roles that amphibious vehicles had to undertake. Some armed forces wanted them simply as personnel or supply carriers that could support amphibious operations, others needed specialized reconnaissance vehicles that could cross water obstacles, and yet others required load carriers to transport supplies anywhere. They are all included in this study so it would be unfair to make comparisons between say, the M29C Weasel and the Soviet T-38 amphibious light tank. The same disparities make comparisons between the DD Shermans and the Japanese Type 2 Ka-Mi impossible, for the DD Sherman was intended simply to accomplish a short journey from a vessel to a nearby shore where it immediately became a gun tank, while the Type 2 was more of a reconnaissance vehicle that could cross water obstacles.

Yet for all these differences the contents of this study include many of the most interesting vehicles used during World War II. Each of the types described here has some special design or other point in its favour although a few have more against than for them. Perhaps the most interesting of all, and not only from a viewpoint of importance, were the American LVTs. These vehicles were very much a compromise design to obtain the best possible overland and water performances. The two are disparate requirements, but the LVTs achieved a good working compromise and were thus able to carry amphibious warfare from the Rhine to the islands of the Pacific. They were remarkable vehicles, but one can only wonder at how their crews had the courage to use their flimsy charges to approach a defended enemy shore and drive them right at the muzzles of the defender's guns.

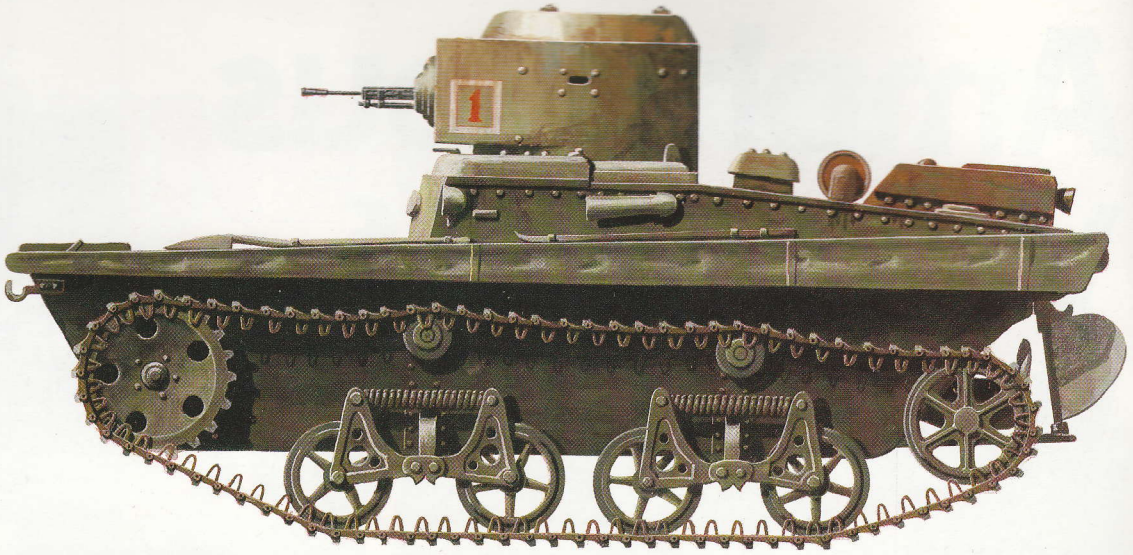
*LVTs do their best to hurry ashore under the cover of a battle-wagon. The vehicles in the foreground are LVT(A) 4s, armed with the turret and 75-mm (2.95-in) main weapon of the M8 Howitzer Motor Carriage, which were used to provide local fire support in the early stages of a landing.*

USSR

# T-37

In 1931 the USSR purchased from Vickers Carden-Loyd of the UK a number of light tankettes. Among the purchases were a small number of Carden-Loyd A4E11 amphibious tanks, and these so impressed the Soviets that they decided to undertake local licence production in order to meet a Red Army requirement for light scouting tanks. However, it was not long before the Soviet design teams realized that the Carden-Loyd A4E11 did not meet all their requirements, and so they set about developing their own light amphibious tank based on the British design. This resulted in the **T-33**, which was subjected to some rigorous trials before it was deemed unsatisfactory. Further design work resulted in the **T-37** light amphibious tank.

By the time the T-37 was produced there was little left of the original British design other than the concept. The T-37 had a GAZ AA engine and the suspension was an improved version of that used on the French AMR light tank. Once again the first T-37s were subjected to a thorough testing programme, and as a result changes were introduced to the full production models, which first came off the lines in late 1933 and early 1934. The production T-37 was a small vehicle with a two-man crew, the commander in a turret offset to the right and the driver seated in the hull to the immediate left. Most of the buoyancy came from two pontoons on each side of the upper hull above the tracks, and at the rear there was the usual single propeller and a rudder. The T-37 was meant to be amphibious on inland waterways only. As it was designed as a light scouting or reconnaissance vehicle, the T-37 had only light armament, comprising a single 7.62-mm (0.3-in) air-cooled machine-gun.

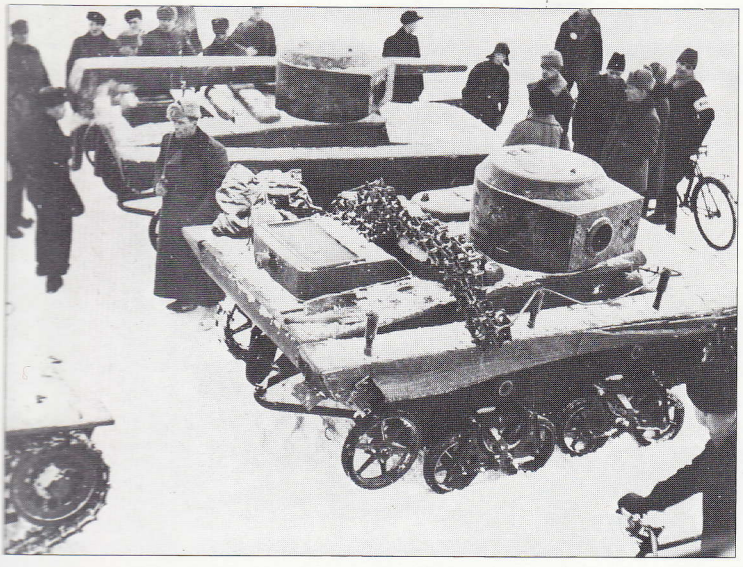


*Above: The tiny T-37 light amphibious tank was produced in several versions, but all were lightly armoured and had only two-man crews. They were in production from 1935 onwards, but few survived after the end of 1941 as they were too frail to stand up to prolonged combat.*

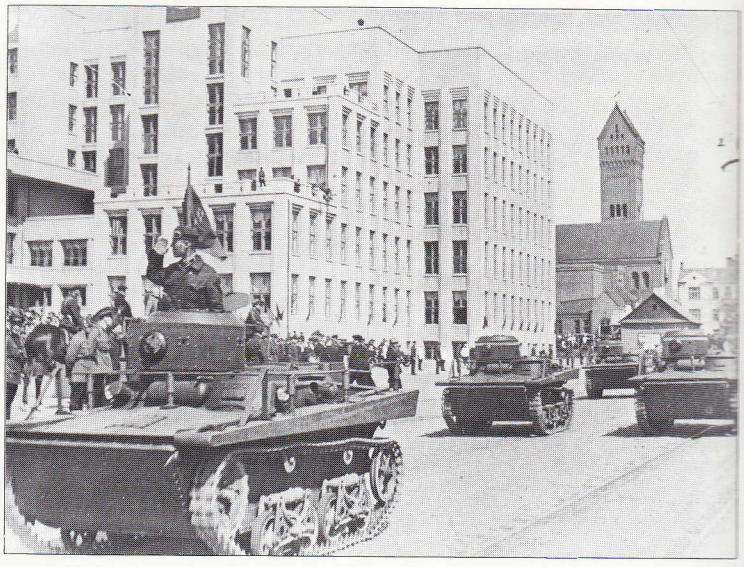
Production of the T-37 continued until 1936, and during the production run several variants occurred. One was known as the **T-37TU** and had a prominent radio frame aerial around the upper hull; this was used only by commanders needing to maintain contact with rear command levels, while orders were transmitted to other tanks by signal flags. On some vehicles the usual riveted turret was replaced by a cast item. As was to be expected on such a small and light tank, armour was very thin, the maximum being only 9 mm (0.354 in) thick and the norm only 3 mm (0.118 in). This armour could not withstand even light anti-armour projectiles, but the T-37s were to be used as scouting vehicles only and were not intended for employment in a stand-up armoured fight. Nevertheless they were so used during the desperate days of 1941 and 1942 when the Soviet army had at times virtually nothing with which to stem the advance of the German forces. By the end of 1942 the last of the T-37s had passed from use, though a few hulls were retained for use as light tractors.

## Specification

**T-37**
**Crew:** 2
**Weight:** 3200 kg (7,055 lb)
**Powerplant:** one GAZ AA petrol engine developing 29.8 kW (40 hp)
**Dimensions:** length 3.75 m (12 ft 3.6 in); width 2.10 m (6 ft 10.7 in); height 1.82 m (5 ft 11.7 in)
**Performance:** maximum road speed 56.3 km/h (35 mph); maximum road range 185 km (115 miles)
**Armament:** one 7.62-mm (0.3-in) DT machine-gun



*Disabled T-37 light amphibious tanks are seen in the snow of the Winter War against the Finns in 1939-1940. In this campaign the T-37s showed up badly, as they had only light armour. The front vehicle is a T-37(TU) command tank with the remains of an aerial showing.*



*T-37 light amphibious tanks on parade in the Soviet Union. The three leading tanks are T-37(TU) command tanks fitted with frame aerials and radios; most T-37s had to communicate with flag signals as the general issue of tank radios was not standard practice until after 1945.*

USSR

# T-38

Almost as soon as the first T-37 amphibious light tanks were rolling off the production lines a redesign was under way. A team based in Moscow virtually took apart the design of the T-37 and did whatever it could to improve and modernize it, for it was realized by 1934 that the basic T-37 design approach was already out of date. The result was known as the **T-38**, and although it looked very different to the T-37 was very little advanced over the original.

The T-38 was of the same general concept as the T-37 and the two-man crew was retained, but the turret position was switched to the left and the driver's position was also switched. The T-38 was wider than the T-37 and had better floating characteristics. Carried over from the T-37 was the armament of a single 7.62-mm (0.3-in) DT machine-gun and the power train of the GAZ AA truck.

The first T-38 was built in 1936 and full production commenced in the following year. Manufacture continued until 1939, by which time about 1,300 had been completed. Some changes were introduced during the production run, the first of which was the **T-38-M1**, an attempt to introduce a new transmission system that in the end proved too complicated for mass production. Then came the **T-38-M2** which was accepted, for it used the power

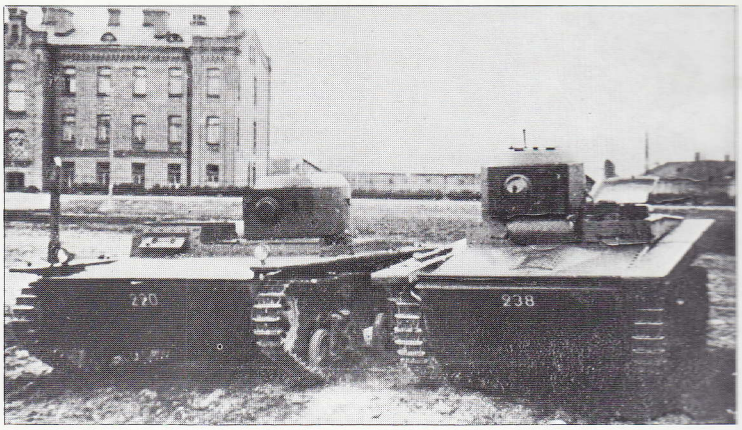
train and engine of the then-new GAZ-M1 truck. One field modification was the changing of the machine-gun for a 20-mm ShVAK cannon to produce more firepower.

When the T-38 went into action alongside the T-37 during the 1939-40 campaign in Finland, the weaknesses of the design became very apparent. The tank was quite simply too lightly protected, for even machine-gun projectiles could pierce the thin armour and knock out the vehicle. Despite attempts by their crews to keep out of the way and simply observe enemy positions, the T-37s and T-38s were shown to be too vulnerable on the battlefield; but they were not immediately withdrawn, for the simple reason that there was nothing to replace them at that time. Instead T-38s were still in use until 1942 to the detriment of their crews, who suffered heavy casualties as Soviet army commanders attempted to use them as light support tanks.

In an attempt to continue the use of the existing T-38 production facilities an effort was made to develop the T-38 by adding some extra armour but the result offered few advantages over the original and the project was terminated.

The T-38 did take part in some interesting experiments involving radio control. The idea was that T-26 light tanks packed with explosives should be directed towards bridges or other demolition targets and then exploded by radio command from a T-38. The T-38 was equipped with special radios for the purpose and was even given a new designation, **NII-20**. There are references to this demolition method being used during the Finnish campaign, but its success is not recorded.

### Specification
**T-38**
**Crew:** 2
**Weight:** 3300 kg (7,275 lb)
**Powerplant:** one GAZ AA or GAZ M-1 petrol engine developing 29.8 kW (40 hp)
**Dimensions:** length 3.78 m (12 ft 4.8 in); width 3.33 m (10 ft 11.1 in); height 1.63 m (5 ft 4.2 in)
**Performance:** maximum road speed 40 km/h (24.9 mph); maximum road range 170 km (105.6 miles)
**Armament:** one 7.62-mm (0.3-in) DT machine-gun or one 20-mm ShVAK cannon



*The T-38 (left) could easily be distinguished from the T-37: the turret was now mounted on the left hand side, and the driver's position moved to the right. It remained utterly inadequate as a combat vehicle.*

USSR

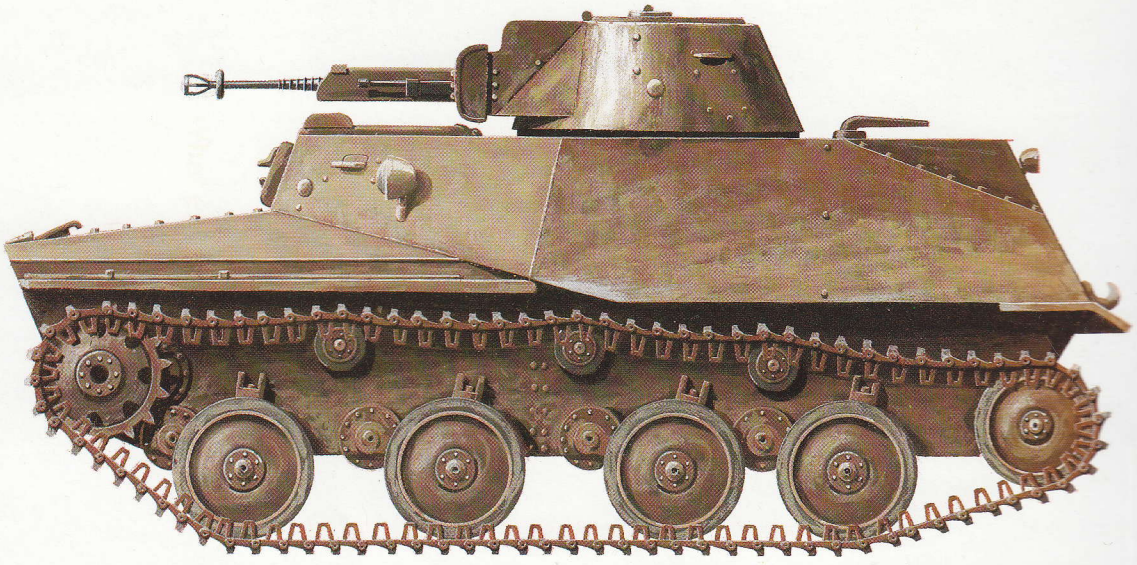
## T-40

Despite the lack of success of the T-37 and T-38 series, the planning authorities of the Red Army still considered there was a need for a light amphibious tank for reconnaissance purposes, and in 1938 a design team in Moscow was given the task of producing a replacement for the T-38. But for once an alternative to an amphibious vehicle was demanded, and it was decided to produce amphibious and non-amphibious versions of the same design: these were given the designations of **T-30A** (amphibious) and **T-30B** (non-amphibious).

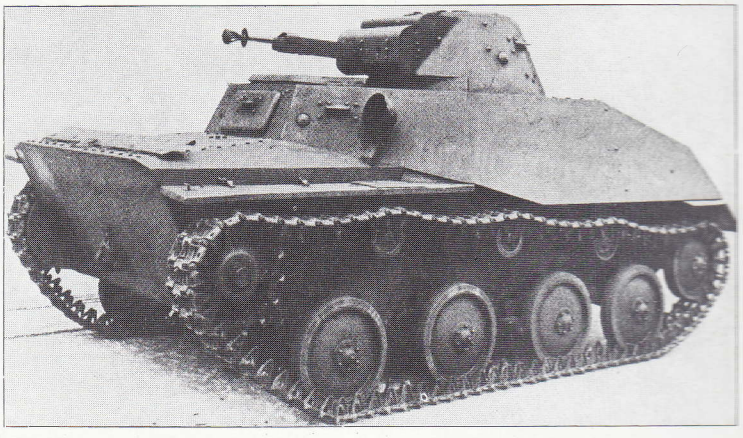
The T-30A was completed during 1939 and the end of that year it had been accepted for Soviet army service as the **T-40**. In order to speed production the T-40 had been designed from the outset to include as many automobile and truck components as possible, but production was surprisingly slow, no doubt as a result of the low priority given to light tanks at that time. Compared to the earlier T-37 and T-38, the T-40 was an entirely new vehicle. The two-man crew was retained, but the small turret was now mounted in a more orthodox slightly offset position and mounted a 12.7-mm (0.5-in) DShK heavy machine-gun. (It had originally been suggested that a 20-mm cannon should be mounted.) The rear of the hull was rather bulky in order to provide the necessary flotation chambers. The original production versions had a blunt nose that did little for swimming characteristics, so this was later rounded off to a more streamlined outline in a version known as the **T-40A**. Propulsion in water was provided by a propeller at the rear, and there was a single rudder.

The main disadvantage of the T-40 continued to be the thin armour that had to be used. On the T-40 this was at best 14 mm (0.55-in), with the norm only 7 mm (0.275 in). By 1940 this was considered to be far too light, mainly as a result of operational experience gained during the fighting of the previous winter in Finland. It was decided that if the amphibious properties of the T-40 were dispensed with, more armour could be carried and the resultant vehicle could be issued to armoured units where river crossings were an unlikely occurrence. A vehicle known as the **T-40S** was produced, but it emerged that this model would require far more production facilities than the original and it was bulkier as well, so that line of development was dropped. Instead it was decided to turn to the T-30B, the non-amphibious version of the prototypes produced in 1939. This was accepted for service as the **T-60**, which soon replaced the T-40 as the Soviet army's new light reconnaissance tank.

Thus the T-40 was not manufactured in very large numbers, and production ceased after only about 225 had been built (a trifling quantity by Soviet standards) and the Soviet light amphibious tank line came to an abrupt end.



*The T-40 used as many automobile components as possible to speed production. It was armed with a 12.7-mm (0.50-in) machine-gun, although some mounted a 20-mm (0.787-in) cannon. Relatively few were produced.*



*The T-40 was in small-scale service with reconnaissance units of cavalry and armoured formations in 1941, but was already being replaced by the slightly improved T-60.*

### Specification
**T-40**
**Crew:** 2
**Weight:** 5900 kg (13,007 lb)
**Powerplant:** one GAZ-202 petrol engine developing 52.2 kW (70 bhp)
**Dimensions:** length 4.11 m (13 ft 5.8 in); width 2.33 m (7 ft 7.7 in); height 1.95 m (6 ft 4.8 in)
**Performance:** maximum road speed 44 km/h (27.3 mph); maximum road range 360 km (223.7 miles)
**Armament:** one 12.7-mm (0.5-in) DShK machine-gun

# Storming the Rhine

*By the middle of March 1945, the Allied armies in the west had reached the Rhine and were poised to invade the German heartland. To ensure a successful crossing, artillery was massed on an eastern front scale and 14,000 parachutists made ready to attack. In the forefront of the assault were the amphibians; DD Shermans swam across together with waves of infantry in LVTs.*

In June 1940 the British army was booted out of France, leaving almost all of its equipment behind. It was bemused by a new form of warfare that most of its men did not comprehend, but once back in the UK the core of professional soldiers still left set about forming new armies with new skills to defeat their determined enemy. In June 1944 the new British citizen armies had been trained to the point at which they could carry out the most difficult of all military operations, an amphibious landing on a defended coast, and by March 1945 they were set to carry out a similar operation all over again: they were going to cross the River Rhine into the heartland of the German enemy.

The British army was not alone. As Allies they had the Americans, the Canadians and many others, and the British army of 1945 was equipped in a manner the army of 1940 could not have comprehended. It was also vastly better organized: it had to be, for the operation it was about to unleash was to be one of the largest of its kind ever contemplated. The army had to amass a vast array of men and equipment ready to cross one of the widest rivers in Europe in the face of an enemy determined to keep the Allies away from the Fatherland. It was to be not just a simple crossing but a combined operation in which the Allied air forces, armies, airborne forces and even some naval elements would have to work together in a co-ordinated manner.

## Advance to the border

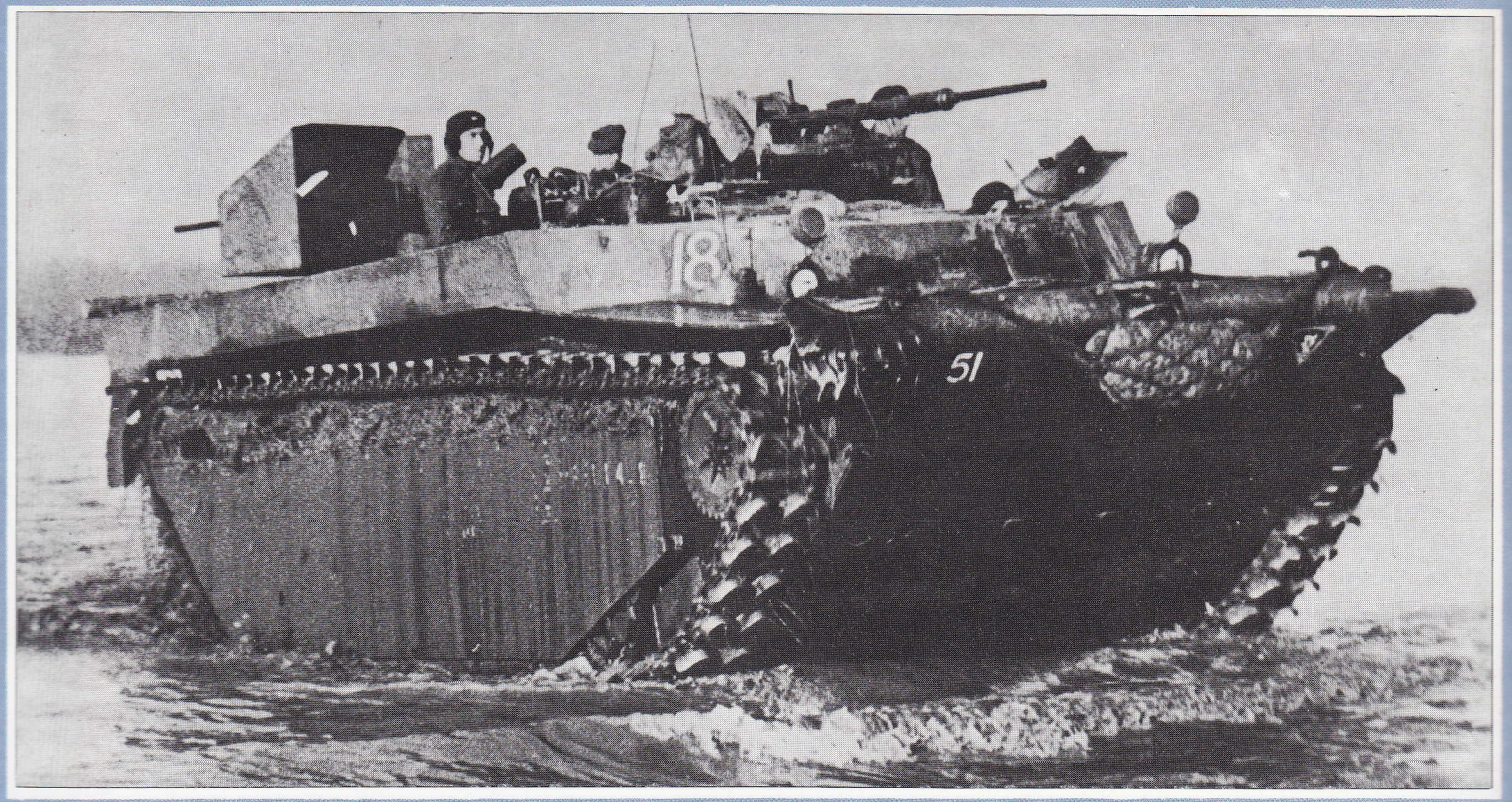
The campaigns of late 1944 were concerned with clearing the route to the German borders. After the failure of the ambitious 'Market Garden' operations at Arnhem it was appreciated that the approaches to Germany were not going to be as rapid as at first hoped. The German counteroffensive through the Ardennes at the turn of the year made the Allies appreciate fully that Germany was as yet far from beaten, and made them far more cautious. But by early March 1945 the approaches to the Rhine near Wesel had been completed and the build-up began.

Planning for the Rhine crossings had been started even before the previous year had ended. It was not just a matter of piling up men and supplies for the crossing as a great deal of training was necessary for the specialized techniques to be used. One of the largest training programmes concerned the conversion of several tank regiments to the use of LVTs, or Buffaloes as they were known to the British. These Buffaloes were to be used to carry the first waves of men across and they were to be followed up by a second wave travelling in assault boats. The crossings were also to involve a considerable engineer involvement. Not only had the bridging equipment necessary to cross the Rhine to be assembled ready for use, but approach roads and other transport facilities had to be made ready. In the end this was managed only by the allocation of several US Army engineer regiments to help out. Ultimately over a quarter of all supplies and equipment involved in the Rhine crossings was that of engineer units.

*A Buffalo of the 79th Armoured Division carries troops across the Rhine in the aftermath of Operation 'Veritable'. Note how low the vehicle is in the water and how little freeboard there was once the vehicle was fully loaded. Each Buffalo had a basic crew of three.*

The Allies were taking no chances. The Allied air forces were provided with the task of completely neutralizing the rump of the Luftwaffe left after the Ardennes offensive of the previous winter. Standing patrols were established over all Luftwaffe airfields likely to become involved in the crossings, mainly to prevent the Luftwaffe seeing the vast build-up of men and *matériel* close to the crossing points. New railheads had to be established to enable 662 tanks of all kinds, 4,000 tank transporters and 32,000 vehicles of every variety to be brought up. Moreover, there were no less than 3,500 field and medium guns to be assembled, together with a quantity of really heavy artillery that would cover the main crossings.

*British Army LVTs were known as Buffaloes, and were used mainly by the 79th Armoured Division. Many Buffaloes were armed with 20-mm (0.78-in) Polsten cannon for the Rhine crossings, and many carried extra machine-guns.*



To add to the planners' problems the Rhine had its own say in the matter. The area where the crossings were to be made is flat and prone to flooding, and the previous winter had been so wet that by March the flood plains were still very wet: it was ideal for the Buffaloes but not so easy for the other vehicles, though it was a risk that had to be accepted.

On the night of 23 March 1945 the crossings began under a barrage from all of the artillery weapons that had been assembled. The first troops went across in Buffaloes with numbers of DD Shermans and other special vehicles in train. The enemy did their best to counter the first waves but the preparation had been such that local air support was often able to clear a path for the landing forces. This air support was so intense that Wesel itself was confidently bombed by the might of RAF Bomber Command when Allies troops were only a few hundred metres away. This not only cleared Wesel of the enemy but prevented the Germans from moving through Wesel to counterattack.

The Allies did not have it all their own way. The mud was so bad in places that not even the Buffaloes could make much forward progress, with the result that some of the second assault waves, crossing in boats, came under intense fire and took heavy casualties. Some of the assault waves used infantry-carrying landing craft that had been brought to the Rhine on special tank transporters.

Opposition to the landings was patchy. In places the defenders fought fiercely and in others the preliminary bombardment had been so fierce that organized defence was slight. The sheer weight of the onslaught was such that in places the Allies were soon able to wade ashore and establish sizeable bridgeheads, but the main strength of the attack was yet to come.

## Assault from the air

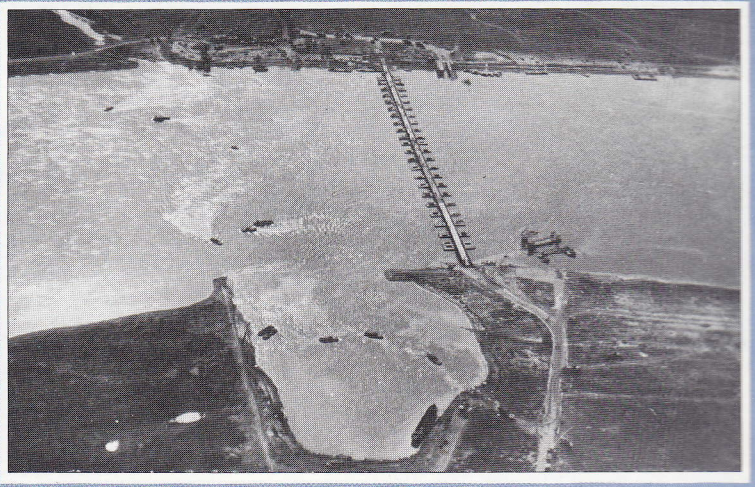
This arrived at about mid-day when the first of the Allied airborne forces came into sight. What became known as the 'armada of the air' flew over the Rhine to disgorge two divisions of parachute troops who seemed at times to make the sky dark with their numbers. They were soon followed by glider tugs that unleashed their charges to land in an area known as the Diersfordter Wald and another known as the Mehr-Hamminkeln. These glider troops did not land unscathed. Despite all efforts of the Allied air forces to neutralize flak sites near the landing points, some guns escaped to concentrate their fire power on the gliders, and about one quarter of all glider pilots involved became casualties in this operation. But it was to no avail as far as the Germans were concerned. The numbers that did land safely were such that the airborne forces and the troops that had made the river crossings were able to join up, often well in advance of the anticipated times. By nightfall the Rhine bridgeheads were secure and despite some localized German counterattacks they were across the river to stay.

Meanwhile the crossings had to be followed up. As early as the afternoon of 24 March the first Allied tanks were being ferried across the river. By nightfall the engineers had started to build the first of many Bailey bridges that would carry the bulk of the Allied armies across to take the fighting farther into Germany. All day long the assault Buffaloes ferried back and forth carrying yet more men and supplies, and alongside them DUKWs and Terrapins shuttled to and forth. Overhead the Allied air forces kept the Luftwaffe at bay and the smooth progress of vast numbers of vehicles was maintained. It was all a far cry from the events of June 1940.

*DUKWs shuttle back and forth by the side of a pontoon bridge just 24 hours after the first British troops carved out a bridgehead. Despite localized counter-attacks, the success of the crossing was assured by the night of 24 March.*

*Above: Buffaloes of the 79th Armoured Division ferry men of the Cheshire Regiment over the Rhine in support of the 1st Commando Brigade. In the background is the twisted wreckage of the railway bridge at Wesel. Note the 20-mm (0.78-in) Polsten guns carried in addition to the machine-guns.*

*Above: Duplex Drive (DD) Shermans are seen immediately after the Rhine crossings, with their wading screens collapsed to allow them to use their main 75-mm (2.95-in) guns. In the background is a Hamilcar, the largest of all the British wartime gliders.*



UK

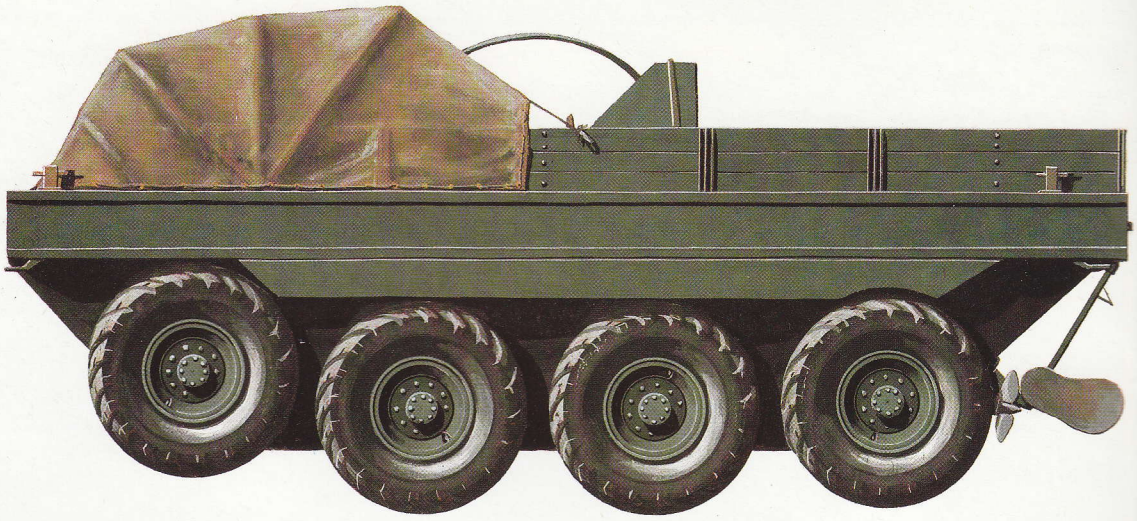
# Terrapin

The **Terrapin** was the British equivalent of the American DUKW, and although it was never built in the numbers that the DUKW achieved it made a useful addition to the amphibious load-carrying fleet used by the British army in 1944-5.

The Terrapin was designed by Thornycroft, but production was carried out by Morris Commercial. About 500 were built, and the bulk of them were used by the 79th Armoured Division, first going into action during the autumn of 1944 when they were used to supplement DUKWs during operations to open up the water approaches to Antwerp. The Terrapin was a straightforward amphibious design but it had some odd features, some of which were not to its advantage. One concerned its two Ford V-8 petrol engines, each one driving the four wheels set along each side; with the Terrapin in the water, the engines each drove one of the two propellers at the rear. The snag with this arrangement turned out to be that if one of the engines stalled for any reason the other engine kept driving, causing the vehicle to go into a rapid turn which could cause alarm and damage to all concerned. Thus Terrapin drivers had to be specially alert to this hazard. The two engines were mounted almost centrally to spread wheel loadings, but this had the effect of dividing the cargo compartments into two halves. Thus although the Terrapin could carry more than the DUKW it could not carry the really large loads such as guns or large vehicles.

The overall performance of the Terrapin was not all that good. It was rather slow on land and in the water, and it was in the water that this performance really mattered. When fully loaded the Terrapin had only a limited freeboard and it could be all too easily swamped in rough water. The top of the vehicle was completely open, but raised moulding boards around the holds could keep out the worst of the water. The driver was located roughly in the centre of the vehicle and his view to the front and rear was rather limited, meaning that other crew members had to give directions during tight landings or when travelling through restricted urban areas. The Terrapin was also a rather uncomfortable vehicle during bad weather conditions. Being seated in the open the driver and crew had to rough it, but an awning could be raised over the front compartment. This was meant to act as a spray shield in the water, but it could also double as weather protection; the trouble was that it restricted even further the driver's forward view.

For all these drawbacks the Terrapin gave good service. Even before it was used operationally some of the drawbacks had been realized and Thornycroft was asked to produce a new design. This emerged as the **Terrapin Mk 2**, the original model thereupon becoming the **Terrapin Mk 1**. It had a large 'one-piece' hold, much better all-round performance and the driver positioned well forward under cover. The hull shape was improved to provide better seaworthiness and water manoeuvrability was much improved. But the Terrapin Mk 2 arrived on the scene too late: the war ended before it could be placed into production and the large numbers of DUKWs to hand meant there was no point in developing it further, and with the end of the war the Terrapin Mk 1s were also withdrawn.



*The Terrapin was powered by two Ford V-8 petrol engines and was driven in the water by two propellers at the rear. There were two cargo holds and the driver sat in the centre of the vehicle.*

## Specification

**Terrapin Mk 1**
**Crew:** 1 + at least 2
**Weights:** unloaded 6909 kg (15,232 lb); loaded 12015 kg (26,488 lb)
**Powerplant:** two Ford V-8 petrol engines each developing 63.4 kW (85 bhp)
**Dimensions:** length 7.01 m (23 ft); width 2.67 m (8 ft 9 in); height 2.92 m (9 ft 7 in)
**Performance:** maximum land speed 24.14 km/h (15 mph); maximum water speed 8 km/h (5 mph)
**Armament:** none

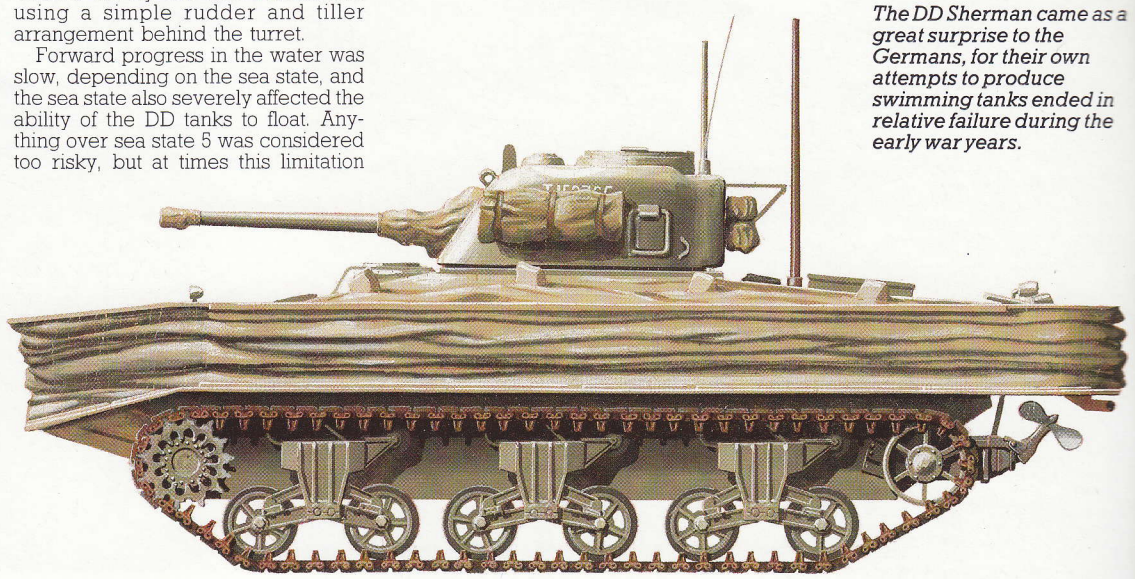
UK

# DD Sherman

The **DD Sherman** was a British development that started during 1941. An engineer named Nicholas Straussler, who had been involved with armoured vehicles for some time, turned his attention to producing a method by which an ordinary tank could float in water during amphibious operations. Early experiments involved the Tetrarch light tank (Valentines were also used at a later date) but in the end it was decided to standardize the eventual results on the Sherman tank, then available in some numbers. To provide a cover, these floating tanks were named Duplex Drive (DD) Shermans.

The first DD Shermans were ready in 1943 and were converted by the addition of a collapsible fabric screen and 36 rubber air tubes or pillars. This screen/tube assembly was attached to a boat-shaped platform welded around the hull of the tank. The idea was that the pillars were inflated from two air cylinders carried on the tank, and as the inflation continued the pillars raised the screen to a point above the level of the turret. The screen was then locked into position by struts. All these operations could be carried out by the crew, and the whole operation could be carried out in 15 minutes aboard a tank landing craft. Once ready, the tank could be driven off the landing craft ramp into the water, where the tank would then float with the turret at water level, about 0.914-m (3-ft) freeboard being provided by the screen. Drive in the water was provided by two small screw propellers at the rear. These were driven via a gearbox from the track drive, and steering was accomplished by swivelling the propellers. Extra steering could be carried out by the tank commander using a simple rudder and tiller arrangement behind the turret.

Forward progress in the water was slow, depending on the sea state, and the sea state also severely affected the ability of the DD tanks to float. Anything over sea state 5 was considered too risky, but at times this limitation was disregarded, often with dire results. Once the DD Sherman was in about 1.5 m (5 ft) of water the screen could then be collapsed. It was here that the main advantage of the DD Sherman became apparent, for it was able to retain its main gun for immediate use after landing. The bow machine-gun could not be fitted to the DD Shermans but the main gun was often used to support 79th Armoured Division operations directly after landing on the beaches, especially during the D-Day landings of 6 June 1944.



*The DD Sherman came as a great surprise to the Germans, for their own attempts to produce swimming tanks ended in relative failure during the early war years.*

Once out of the water the twin propellers could be raised out of the way, and off the beaches the DD Shermans could be used in a normal combat role.

The DD Shermans were the only item of specialized amphibious warfare vehicles used by the US Army in June 1944, and the Americans even produced their own versions. During the Normandy landings the DD Shermans came as a nasty surprise for the German defenders as their own experiments with 'floating' tanks had proved unsuccessful and had been terminated some years earlier. The sight of DD Shermans clambering up the beaches was too much for some defenders who promptly made themselves scarce. In other locations the DD Shermans provided invaluable immediate fire support for units already in action on the beaches and in the immediate hinterland. DD Shermans were also used at the Rhine crossings and during some north Italian operations in 1944-5.

*Below: The DD Sherman in the foreground is in the process of lowering its wading screen just after a river crossing. The wading screens were supported on columns of air contained in rubber tubes, and the soldier in the foreground is assisting their collapse.*

*Right: The twin propellers of this DD Sherman can be clearly seen under the wading screen, which is in the collapsed position. Only Shermans were used operationally with DD equipment from D-Day onwards until the crossing of the Elbe in 1945.*

*Above: DD Shermans are seen after crossing the River Elbe in the late stages of the war in Europe in 1945. The wading screens could remain attached to their parent tanks after use, as they did not hinder the tank's fighting efficiency.*

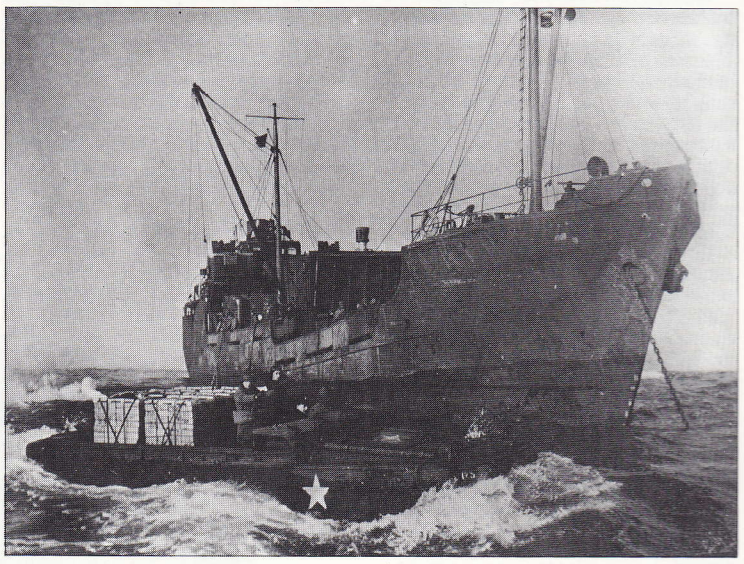
USA

## DUKW

The amphibious truck that became universally known as the **'Duck'** first appeared in 1942, and was a version of the standard GMC 6×6 truck fitted with a boat-like hull to provide buoyancy. It derived its name from the GMC model designation system – D showed that it was a 1942 model, U that it was amphibious, K indicated that it was an all-wheel-drive model, and W denoted twin rear axles. From this came **DUKW**, and this was soon shortened to 'Duck'.

The Duck was produced in large numbers. By the time the war ended 21,147 had been built, and the type was used not only by the US Army but also by the British army and many other Allied armed forces. Being based on a widely-used truck chassis it was a fairly simple amphibious vehicle to maintain and drive, and its performance was such that it could be driven over most types of country. In the water the Duck was moved by a single propeller at the rear driven from the main engine, and steering was carried out using a rudder behind the propeller; extra steering control could be achieved by using the front wheels. The driver was seated in front of the main cargo compartment, which was quite spacious and could just about carry loads such as light artillery weapons – it was even possible to fire some weapons such as the 25-pdr field guns during the 'run in' to a beach. The driver was seated behind a folding windscreen and a canvas cover could be erected over the cargo area. For driving over soft areas such as sand beaches the six wheels used a central tyre pressure-control system.

The Duck was meant for carrying supplies from ships over beaches, but it was used for many other purposes. One advantage was that it did not always have to unload its supplies directly on the beach: on many occasions it was able to drive its load well forward to where the freight was needed and then return. Many were used as troop transports and the number of special-purpose versions were legion. Some were fitted with special weapons, such as the 114.3-mm (4.5-in) rocket-firing version used in the Pacific and known as the **Scorpion**. Mention has been made of field guns firing from the cargo area, and some Ducks were armed with heavy machine-guns for self-defence or anti-aircraft use. A tow hook was fitted at the rear and some vehicles also had a

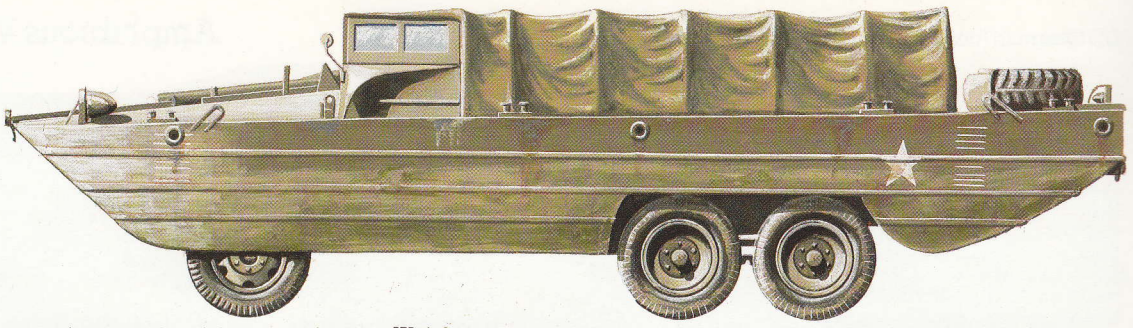


*The main use of the DUKW was as a logistical stores carrier loading supplies from ships standing offshore. They could also carry overland to supply dumps. This DUKW is seen during a training operation in the pre D-Day period in 1944.*

self-recovery winch. Twin bilge pumps were fitted as standard.

Many Ducks were sent to the USSR, and the type so impressed the Soviet army that the USSR produced its own copy, known as the **BAV-485**. This differed from the original by having a small loading ramp at the rear of the cargo area. Many of these BAV-485s are still in use by the Warsaw Pact nations, and the DUKW still serves on with a few Western armed forces. The British army did not pension off its Ducks until the late 1970s.

The Duck has been described as one of the war-winners for the Allies and certainly gave good service wherever it was used. It had some limitations in that the load-carrying capacity was rather light and performance in rough water left something to be desired, but the Duck was a good sturdy vehicle that was well-liked by all who used it.



*This DUKW has its canvas tilt raised over the load-carrying area and the driver's screen raised.*

**Specification: DUKW**
**Crew:** 1+1
**Weights:** unloaded 6750 kg (14,880 lb); loaded 9097 kg (20,055 lb); payload 2347 kg (5,175 lb)
**Powerplant:** one GMC Model 270 engine developing 68.2 kW (91.5 bhp)
**Dimensions:** length 9.75 m (32 ft 0 in); width 2.51 m (8 ft 2.9 in); height 2.69 in (8 ft 10 in)
**Performance:** maximum land speed 80 km/h (50 mph); maximum water speed 9.7 km/h (6 mph)
**Armament:** see text

USA

# LVT 2 and LVT 4

Developed from a civil design intended for use in the Florida swamps, the LVT-1 was not really suited for combat, being intended solely as a supply vehicle. The Pacific war was to prove the need for a more capable amphibious assault vehicle. This emerged as the **LVT 2**, which used a better all-round shape to improve water performance, though it was still a high and bulky vehicle. Another improvement was a new suspension and the track grousers were made better by the use of aluminium W-shaped shoes that were bolted onto the track and could thus be easily changed when worn or damaged. A definite logistic improvement was introduced by use of the engine, final drive and transmission from the M3 light tank. At the time the LVT 2 was being developed these components were readily available and made spare-part supply that much easier.

The steering system of the LVT 2 gave considerable trouble at first, for the brake drums operated in oil and prolonged use of the steering bars could result in the brakes seizing up on one side. Training and experience solved that problem.

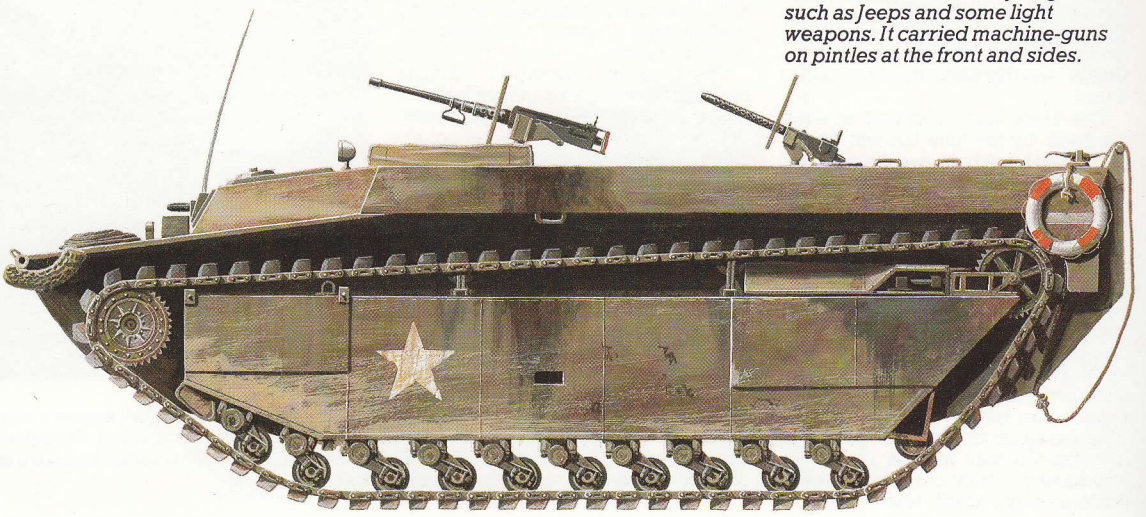
On the LVT 2 the engine was mounted at the rear, which restricted the size of the cargo compartment. This was relatively easily designed out of the overall layout by moving the engine forward and mounting a ramp at the rear to ease loading and unloading. Thus the LVT 2 became the **LVT 4**, which was otherwise generally similar. Of all the LVT series the LVT 4 was produced in the largest numbers: 8,348 produced on five production lines; in contrast 2,963 LVT 2s were produced on six lines. There were some design differences between the LVT 2 and LVT 4: for instance, the driver's controls were rearranged on the LVT 4, but the main improvement was that all manner of loads could be carried on the LVT 4, ranging from a Jeep to a 105-mm (4.13-in) field howitzer.

Most LVT 2s and LVT 4s were armed with 12.7- or 7.62-mm (0.5- or 0.3-in) machine-guns on rails or pintles, but there were two versions of the LVT 2 that had heavier weapons. The **LVT(A) 1** was an LVT with an M3 light tank turret mounting a 37-mm gun; this was intended to supply fire support during the early phases of an amphibious landing during the interval immediately after reaching the beaches. The gun proved to be too light for this role, so it was later supplanted by the short 75-mm (2.95-in) howitzer mounted in the turret of the M8 Howitzer Motor Carriage to produce the **LVT(A) 4**. On both of these gun vehicles the turrets were mounted towards the rear of the cargo area, which was covered in by armoured plate.

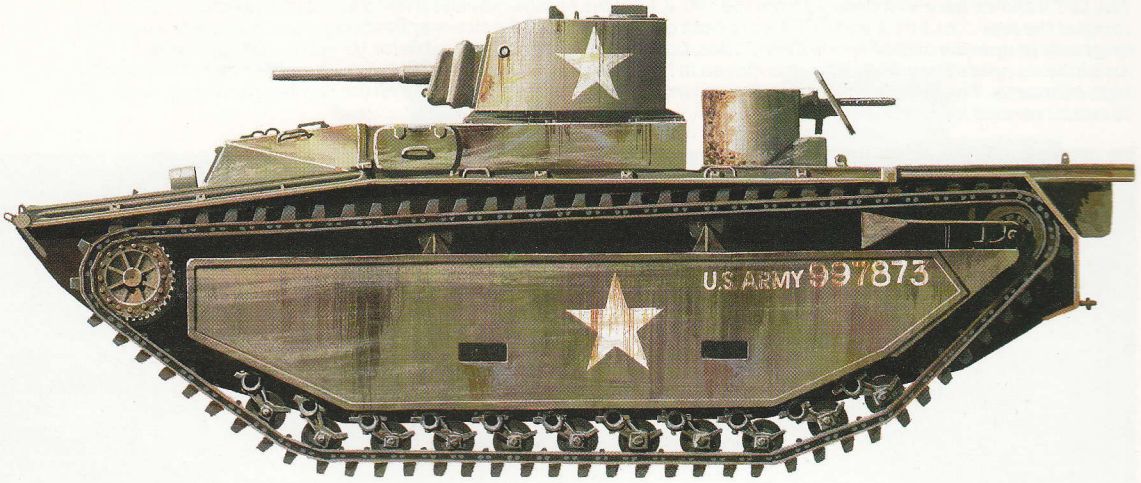
The ordinary LVT 2s and LVT 4s became the main load carriers of the early Pacific operations. The first LVTs were used in action at Guadalcanal, and thereafter every island-hopping operation involved them. Some were used in Europe during the Scheldt and Rhine operations of 1944-5 and there were numerous odd 'one-off' attempts to mount various types of weapon in them, ranging from rocket batteries to light cannon. Flamethrowers were fitted in some numbers, but all these types of armament should not disguise the fact that the LVT 2 and LVT 4 were most often used to carry ashore the first waves of US Marines.

*LVTs lumber ashore during a training exercise, with others following in a non-tactical line; in an assault the LVTs would land in waves side-by-side. The LVT on the right has shielded weapons that could be either machine-guns or flamethrowers.*

*The LVT 4 differed from the LVT 2 in having a loading ramp at the rear, which enabled it to carry large loads such as Jeeps and some light weapons. It carried machine-guns on pintles at the front and sides.*

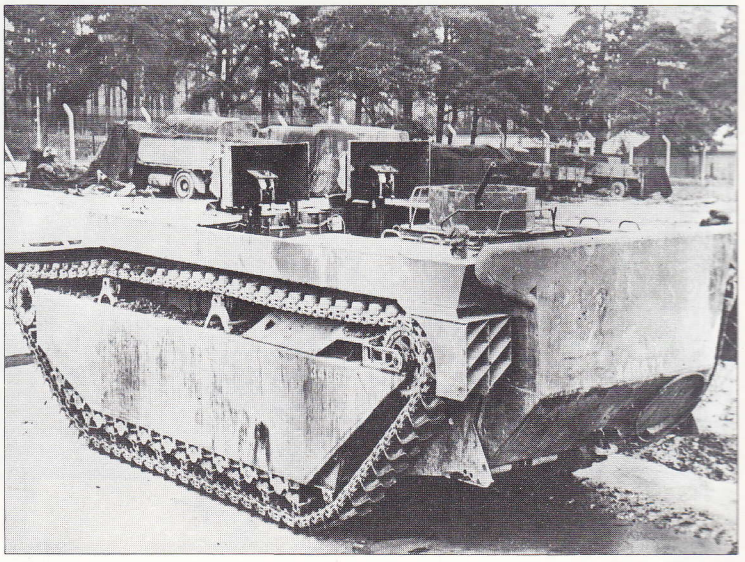


**Specification**
**LVT 2**
**Crew:** 2+7
**Powerplant:** one Continental W970-9A petrol engine developing 186.4 KW (250 hp)
**Weights:** unloaded 11000 kg (24,250 lb); loaded 13721 kg (30,250 lb)
**Dimensions:** length 7.975 m (21 ft 6 in); width 3.25 m (10 ft 8 in); height 2.5 m (8 ft 2.5 in)
**Performance:** maximum land speed 32 km/h (20 mph); maximum water speed 12 km/h (7.5 mph); road radius 241 km (150 miles); maximum water radius 161 km (100 miles)
**Armament:** one 12.7-mm (0.5-in) and one 7.62-mm (0.3-in) machine-guns




*Right: The LVT(A) 1 was armed with the turret and 37-mm (1.45-in) gun of the M3 light tank to provide some measure of local fire support in the initial stages of an amphibious landing.*

*The British Army received a number of LVTs, and knew them as the Buffalo. Here a number are being prepared for the crossing of the River Elbe during the latter stages of the war in north west Europe; it was in these final river crossings that the Buffalo saw most use.*



*The LVT (F), commonly known as the Sea Serpent, was an LVT 4 converted by the British Army to mount two Wasp flamethrowers forward and a machine-gun aft. Despite the potential of this flame weapon the Sea Serpent was little used by the British.*

USA

## LVT 3

Compared with the earlier LVT 1 and LVT 2, the **LVT 3** (or **Bushmaster**) was an entirely new design. For a start it had two engines (Cadillac units), each mounted in a side sponson. This allowed an increase in size of the cargo-carrying area and enabled a loading ramp to be installed at the rear. The overall outline remained the same as on the earlier vehicles, but there were numerous changes. The track was entirely new, being rubber-bushed, and the width was reduced with no detriment to water propulsion which continued to be carried out using the tracks only.

The first LVT 3 appeared during 1945 and by the time production ended 2,692 had been produced. It went on to be the 'standard' post-war vehicle of its type but by 1945 the LVTs were used not only by the US Marines but by the US Army. This service had the usual doubts regarding the efficiency of LVTs, but after its initial misgivings came to value the type's attributes just as much as did the US Marines (although the US Army used the LVT 4 mainly as a supply carrier). For a short while the LVT 3 was used by both the US Marines and the US Navy.

On the LVT 3 the driver and co-driver were located in a cab forward of the cargo area. Behind them was the gunner's firing step and by the time the LVT 3 arrived on the scene the armament of the LVTs had been increased from the initial single machine-gun to three: one 12.7-mm (0.5-in) heavy and two 7.62-mm (0.3-in) medium machine-guns. Along each side of the cargo area were the sponsons containing not only the engines but the hydramatic transmissions, bilge pumps and blowers to remove fumes. Some American references refer to these sponsons as pontoons, for they certainly added to the vehicle buoyancy. The rear ramp was raised and lowered by a hand-operated winch and had heavy rubber seals along the sides to keep out water. Any water that did get in was drained through gratings in the cargo area deck to be dealt with by the bilge pumps.

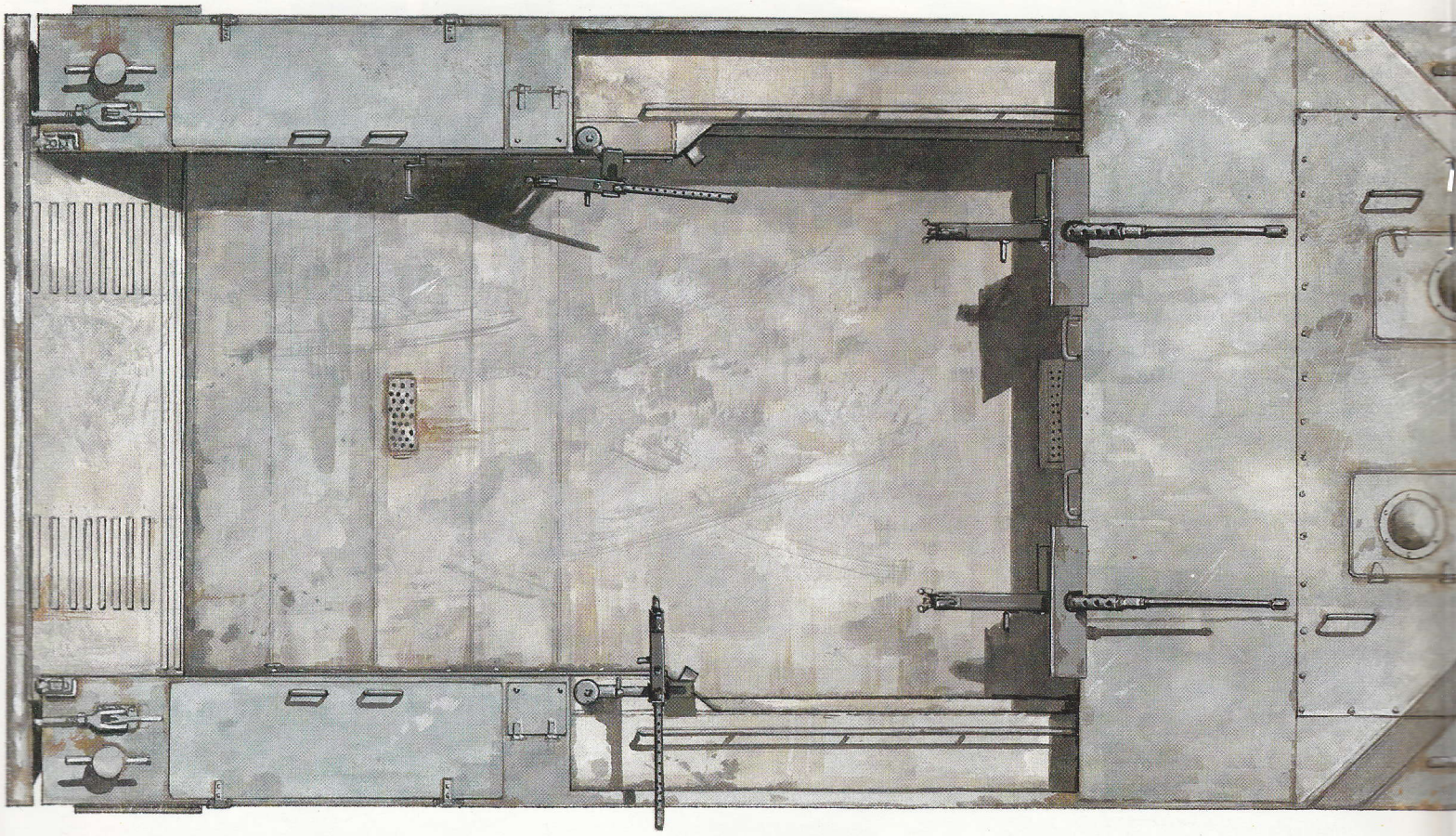
The LVT 3 was armoured like the LVT 2 and LVT 4, but extra protection could be added by means of an armoured cab for the driver and co-driver and by the use of add-on panels of armour. (These armoured panels could also be added to the LVT 2). Extra shields were also available to protect the machine-guns and their gunners. Perhaps the most reassuring item of equipment carried was a wooden box in the driver's cab. This contained a quantity of rags, waste material and tapered wooden plugs of various sizes to stop any leaks caused by enemy action or otherwise induced. Other special-to-type equipment carried included signal lamps, a water tank and even some spare parts for on-the-spot repairs.

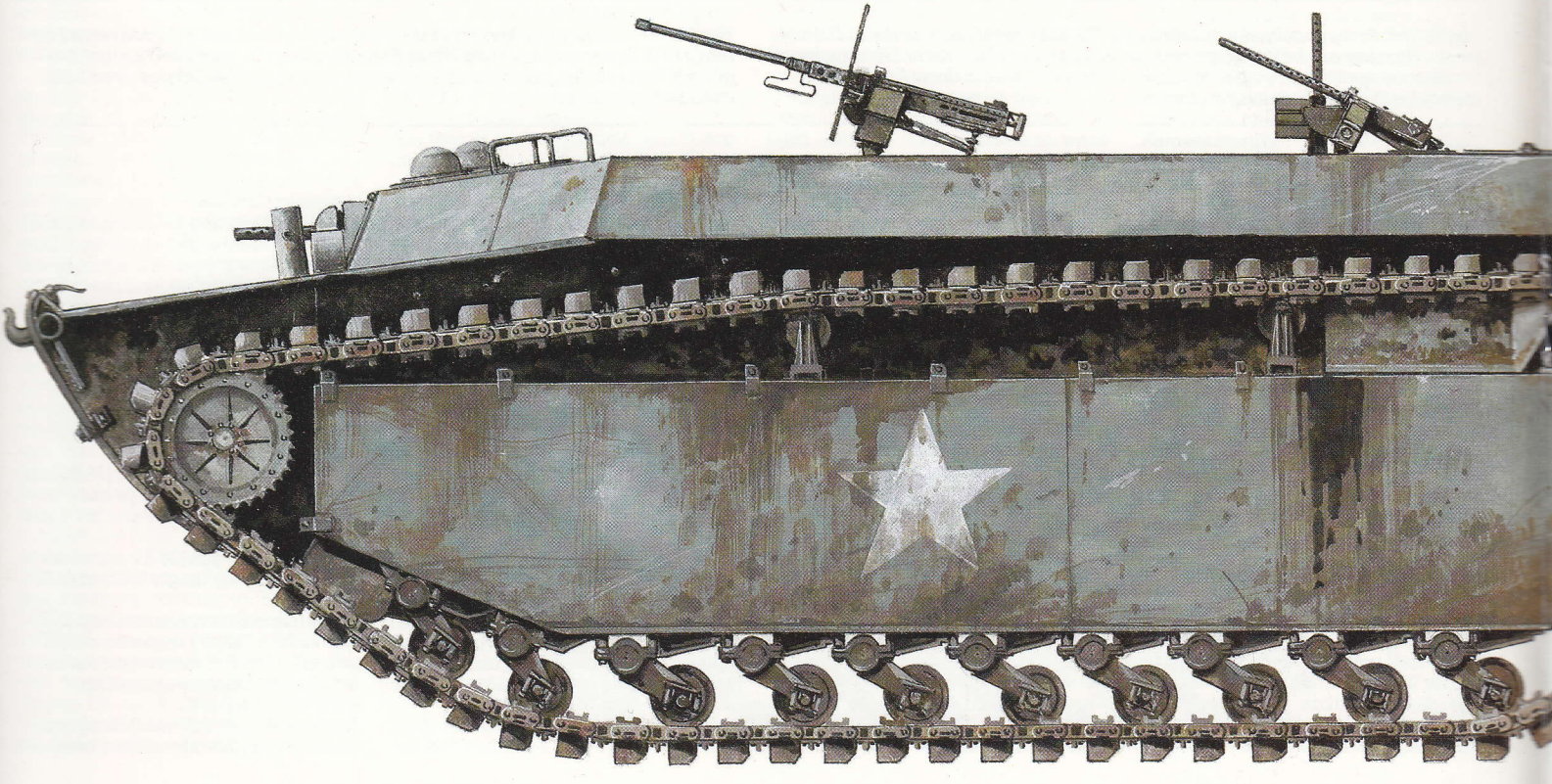
The LVT 3 represented the final wartime point in the line that could be traced back to the Roebling tractors, but it was not the end of the line. During the post-war years the concept was developed still further and many of the present vehicles now in use can trace their origins to the LVTs.

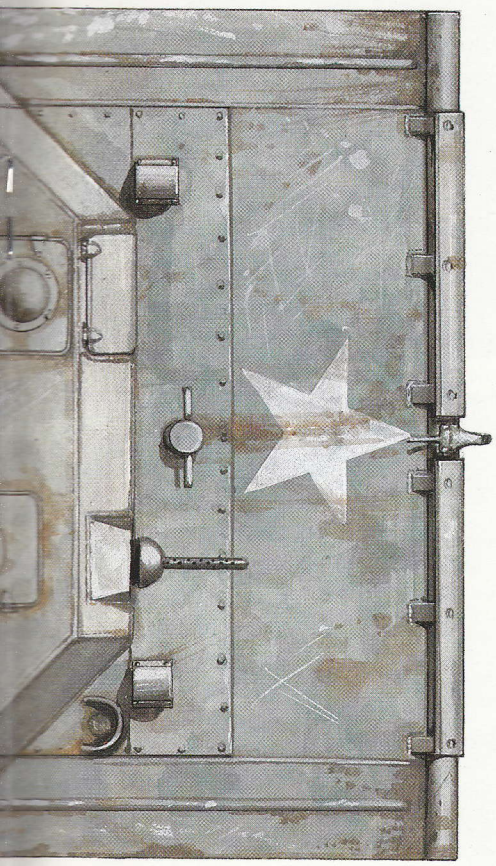
**Specification**
**LVT 3**
**Crew:** 3
**Weights:** unloaded 12065 kg (26,600 lb); loaded 17509 kg (38,600 lb)
**Powerplant:** two Cadillac petrol engines developing a total of 164.1 kW (220 hp)
**Dimensions:** 7.95 m (26 ft 1 in); width 3.25 m (10 ft 8 in); height 3.023 m (9 ft 11 in)
**Performance:** maximum road speed 27.3 km/h (17 mph); maximum water speed 9.7 km/h (6 mph); road radius 241 km (150 miles); water radius 120.7 km (75 miles)
**Armament:** one 12.7-mm (0.5-in) and two 7.62-mm (0.3-in) machine-guns

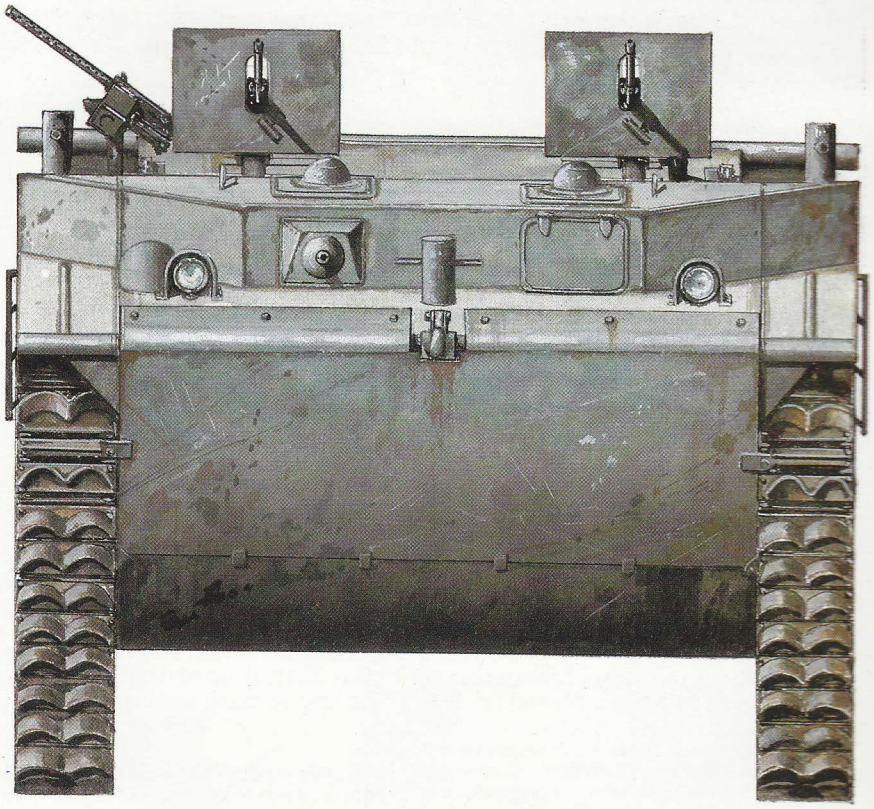
# Landing Vehicle Tracked (LVT 4)

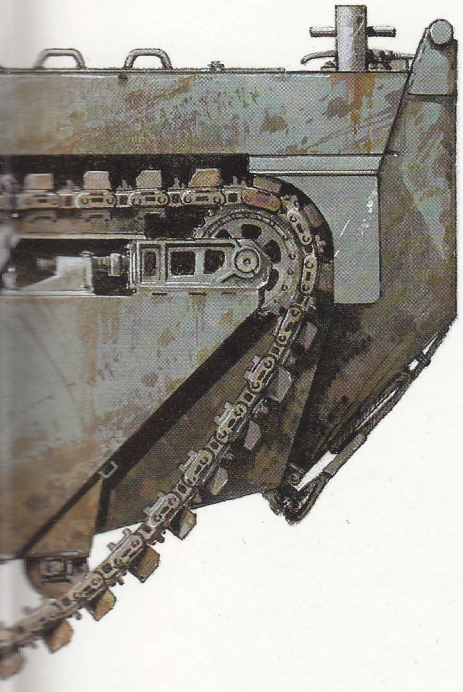
*The LVT 4 shown here was derived from the LVT 2, with the engine moved forward and a downwards-opening ramp at the rear. The LVT 2 and LVT 4 were both developed from the pre-war Roebling tractor that was designed originally to operate in the Florida Everglades, but which was equally suitable for US Marine Corps use in amphibious operations. The LVT 4 was driven in the water by its tracks, and flotation chambers gave the vehicle its high silhouette. The LVTs were used as logistic transports as well as landing craft for Marines, and many were used to mount various forms of armament.*

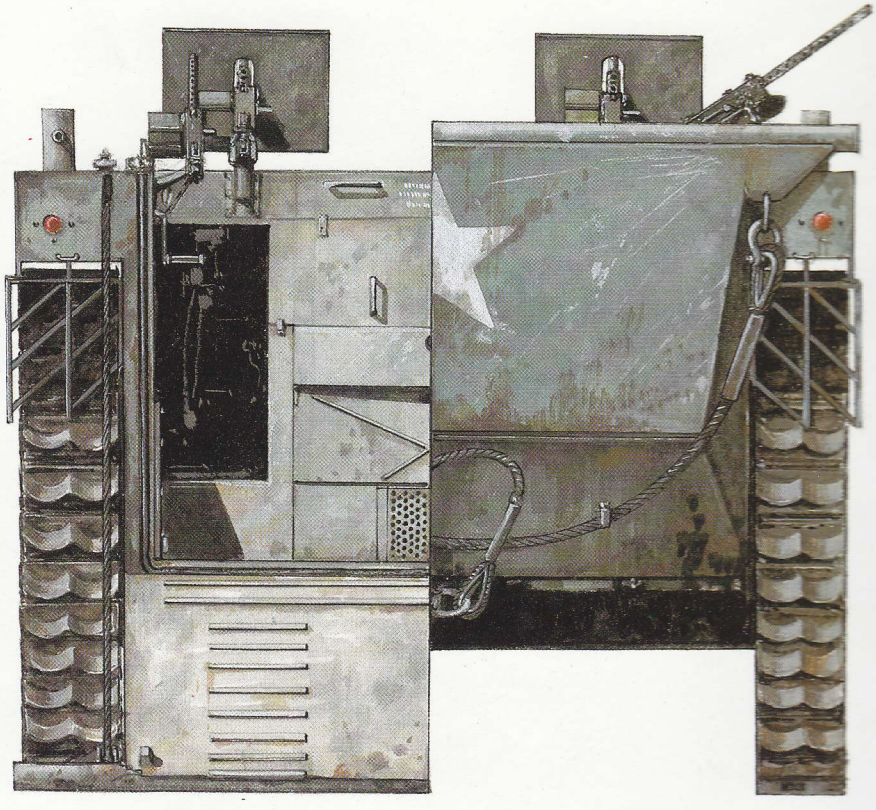












# LVTs at Peleliu

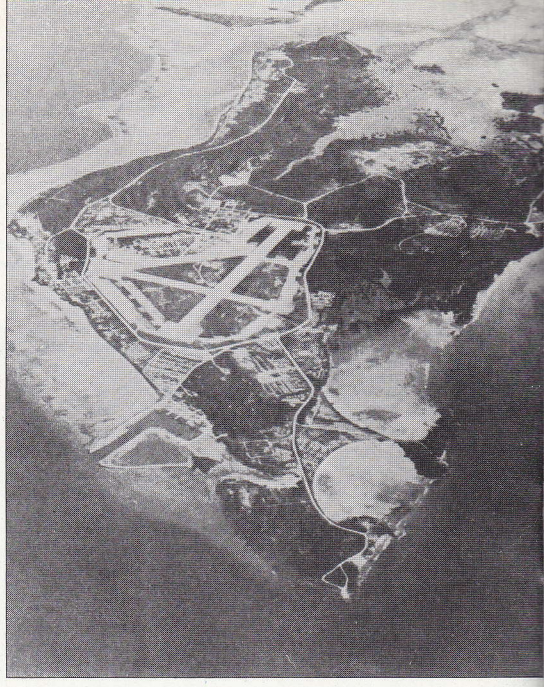
***The Palau Islands were defended by 30,000 Japanese troops, including the crack 14th Division, all commanded by General Sadao Inoue, who stationed one-third of his forces to defend Peleliu and its airfield. The task of capturing this position fell to the 1st US Marine Division; at 8.30 am on 15 September 1944 three Marine regiments began their landing on the south west coast of the island.***

By the time the US Marines were contemplating an amphibious landing on the small island of Peleliu in September 1944, their style of amphibious warfare had become well established. Peleliu was yet another of the islands that had to be taken on the way to the Japanese mainland, and it is situated in the Palau island group some 725 km (450 miles) to the east of the Philippines. Like so many islands that attracted the attentions of the US Marine Corps during the period 1943 to 1945, Peleliu has a coral reef surrounding the central island, which is mainly flat but with a central ridge and a mountain at one end. Its main attraction for the Americans was that it possessed an airstrip from which the Americans could cover the next stage of their island-hopping campaign, so an operation was planned for 15 September 1944.

Peleliu was to prove to be no easy nut to crack, not that any island or defensive position held by the Japanese was easy. There were about 10,000 Japanese on Peleliu, and they had been provided with ample time to dig themselves in and fortify the island. Systems of tunnels and trenches had been blasted or chipped from the coral and a maze of anti-tank ditches on the beach approaches were coupled with a vast maze of obstacles and mines just under the high-water mark. To add to these man-made defences the island is naturally covered in thick scrub and parts of the island are mangrove swamp.

## Valuable experience

If this sounds daunting, it must be remembered that the US Marines were used to such prospects. Starting at Guadalcanal in 1942 and moving through the horrors of Tarawa in late 1943, the US Marines had learned how to overcome even the most strongly defended islands. They relied on several things. One was their overpowering weapon strength, which ranged from the massive naval guns fired from battleships lying offshore to close support from low-flying strike aircraft. They had also learned that tanks landed with the first waves of US Marines were invaluable in providing direct fire-support. It was the co-ordination of all this effort that took up so much of the planning time and cost so many lives while the details were being worked out. By late 1944 the drills had been largely established but there was still much more to be learned, and Peleliu was to



*Peleliu is a small island in the Palau group 725 km (450 miles) east of the Philippines. Its importance in 1944 stemmed from its airfield, centre for the concentration of Japanese air power since the destruction of their base at Truk.*

*The LVTs made their landing under cover of repeated air strikes from US carrier aircraft, but the well-sited Japanese gun emplacements still managed to bring the beachhead under effective fire. Peleliu had been pounded by battleships offshore and bombed by aircraft for the preceding three days, but the limestone ridges had been honeycombed with deep bunkers where the defenders could shelter during the bombardment.*

show how much this was.

The Peleliu landings were for once to be made by a US Marine force weaker in numbers than the defenders, and this time there would be no chance for all the units concerned to have the usual preliminary rehearsals for everyone to shake down. The units involved were too scattered for that, and it was hoped that experience and improvisation would overcome any difficulties. But for once shipping was in short supply, and to add to the overall planning difficulties two of the support battleships collided and had to be withdrawn from the support force. More ships collided en route, and so short was the eventual tonnage available that some tanks had to be left behind. What might have been a deciding factor was that the LVTs were also in short supply, though at the last moment a number arrived and all seemed set.

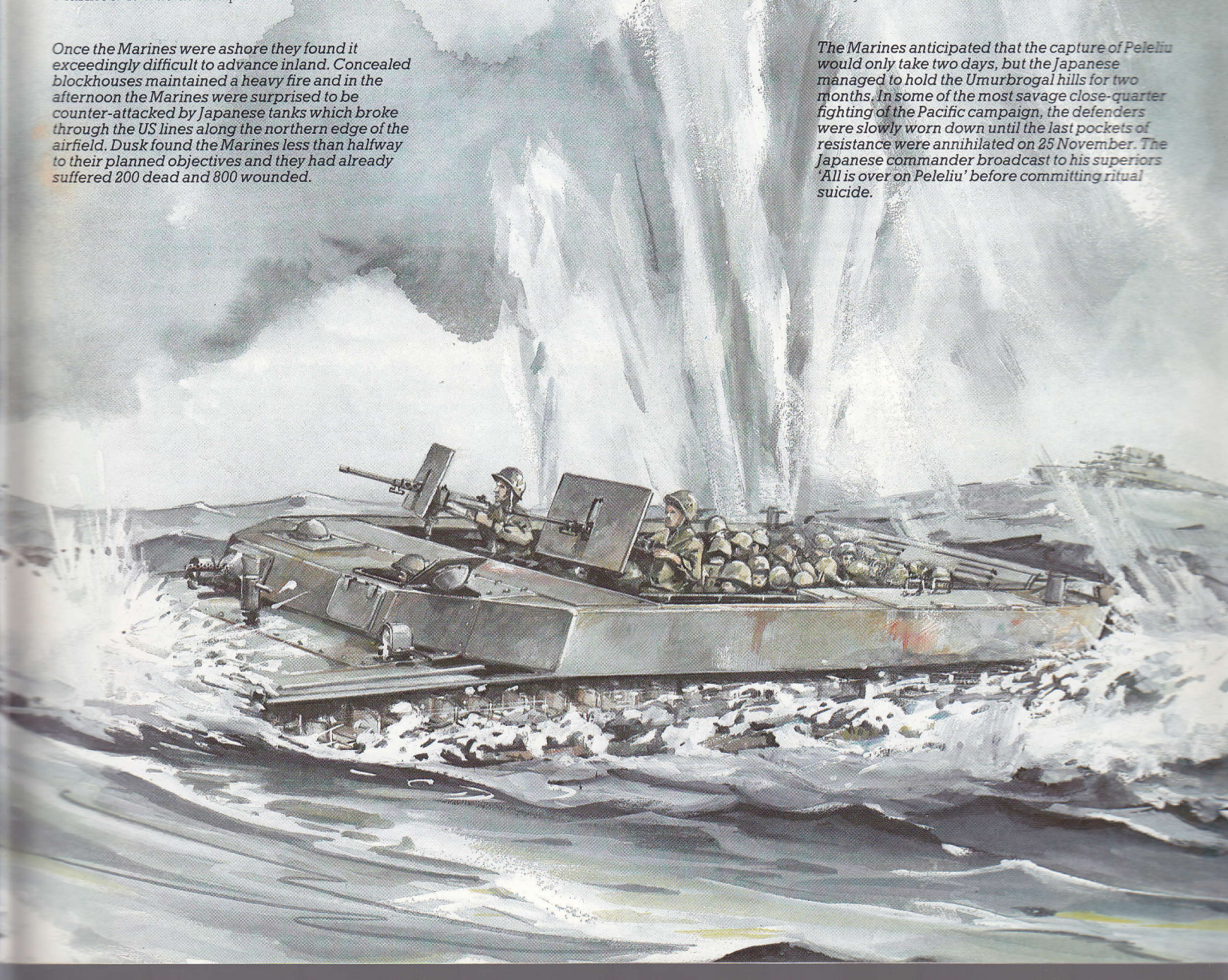
The landing was preceded by the usual naval bombardment of the island. This lasted for three days, but while spectacular it had little effect on the defenders who promptly went underground into their prepared caves and tunnels and waited. They knew what to expect and they also knew that as soon as the bombardment lifted they had to move out quickly to defend themselves against the first waves of US Marines. It was at this point that the strike aircraft were supposed to add their weight to the fray, forcing the defenders to keep their heads down, but in the fog of war this could not always happen.

At Peleliu the interval between the delivery of the air support and the first US Marine landing was prolonged by the number of underwater obstacles scattered off the beaches. Underwater clearance teams had moved in ahead of the first waves, but the very numbers of obstacles these parties encountered meant they could do little more than clear a few paths to the beaches. The first waves were LVTs loaded with US Marine infantry and they suffered badly.

*American Marines crammed into the beachhead immediately after the landings on Peleliu island. During this operation one Marine division was set against over 10,000 well dug-in defenders.*

*Once the Marines were ashore they found it exceedingly difficult to advance inland. Concealed blockhouses maintained a heavy fire and in the afternoon the Marines were surprised to be counter-attacked by Japanese tanks which broke through the US lines along the northern edge of the airfield. Dusk found the Marines less than halfway to their planned objectives and they had already suffered 200 dead and 800 wounded.*

*The Marines anticipated that the capture of Peleliu would only take two days, but the Japanese managed to hold the Umurbrogal hills for two months. In some of the most savage close-quarter fighting of the Pacific campaign, the defenders were slowly worn down until the last pockets of resistance were annihilated on 25 November. The Japanese commander broadcast to his superiors 'All is over on Peleliu' before committing ritual suicide.*



# LVTs at Peleliu

As the LVTs approached the usual coral reefs all was well. The LVTs' tracks enabled them to clamber over the reefs without too much difficulty, but in the calm water inside the reef the casualties mounted. The obstacles not only snagged the LVTs but also blew them up, for underwater mines and aircraft bombs were freely scattered among the stakes and wire, and to add to this the waters were covered by machine-gun and mortar fire from concealed weapon pits. Those vehicles that did reach the beach soon found themselves in a maze of anti-tank ditches. LVT casualties soon mounted and confusion reigned.

## LVTs in the lead

For once the staff planners had decided not to rely upon LVTs alone for the first wave, so the LVTs were quickly followed by tank landing craft that disgorged their loads from close offshore. During the Peleliu landings one innovation was the use of LVTs to 'lead' the tanks ashore. The first vehicle off the landing craft was an LVT which moved on its tracks along the sea bottom. If it started to float the following tanks could not progress so another route ashore had to be found. This simple method ensured that many more tanks than usual found their way ashore and were able to provide the important direct fire support. The 'leader' LVTs were also useful in that they carried with them a small local supply depot to keep the tanks in action.

Tanks were not the only direct fire support weapons, for the LVT units also provided some of their own. In every LVT unit there were a number of LVT(A)s, turreted LVTs armed either with 37-mm tank guns or more useful short 75-mm (2.95-in) howitzers. Despite their relative lack of armour these LVT(A)s proved invaluable in providing fire support in the interval before the first tanks could clamber ashore, and at Peleliu there was another innovation. This was a small number of LVTs armed with naval-pattern flamethrowers. These were supposed to be used with every one of the initial landing waves, but in the confusion caused by the underwater obstacles and by overall lack of command and control following the initial landings, these flamethrower tanks were not used. It was to be the third day of the campaign before the first of them were deployed operationally.

## Heavy fire

The noise and confusion of amphibious landings like that on Peleliu was considerable. As the LVTs moved towards the beaches naval gunfire was noisily sending heavy shells overhead to inland targets, and closer to hand the three machine-guns carried by nearly every LVT were hammering away at anything that seemed a likely target. Around them other LVTs and DUKWs were hitting underwater mines or charges, and all around passed enemy machine-gun fire, mortar bombs and artillery fire. On the beach the presence of anti-tank ditches or anti-tank walls usually meant that the US Marines had to leave their LVTs and move forward on foot. It was at times like those that the LVT 4 rather than the LVT 2 was favoured. The LVT 4 had a rear-mounted ramp while on the LVT 2 the US Marines had to leave over the sides, offering tempting targets to the enemy. Once on the beach the terrain rarely resembled what was expected. Vehicles often landed in the wrong places and the US Marines had to form up as best they could before moving forward to their objectives. All the while the Japanese were doing their best to ensure that no such progress was possible. Thus the LVT(A)s were called upon to blast a way through before the tanks arrived.

Somehow, out of all the confusion on the beaches of Peleliu, some form of command cohesion emerged, and by the end of the first day the beach-head was about 2740 m (3,000 yards) wide and 450 m (500 yards) deep. By the end of the day the LVTs had been able to bring ashore some pack artillery, and a constant stream of LVTs brought more men and supplies. But the beaches were littered with wrecked LVTs, DUKWs and tanks. The Peleliu operations were well under way, however, though the actual fighting lasted until almost the end of November, for as usual the Japanese defenders clung on to every position literally to the death. And much of the offensive was literally uphill work. The US Marines had landed on the lowest part of the island in order to have room to establish a sizeable beach-head but this meant that the flat ground was dominated by the ridge and mountain away to the north. It was there that the Japanese had their main defensive positions, though in such fighting the LVTs could play little part other than keeping the supplies moving from ship to shore.

*This LVT is equipped with a built-up superstructure and three-sided machine-gun shields. Conversions such as this were becoming common during the latter phases of the Pacific campaigns in order to provide the landing troops with extra fire cover.*

*An indication of the close-quarter combat undertaken on Peleliu can be gained from this study of Marines so near to the Japanese positions that one Marine is throwing petrol bombs. Despite this, the restricted nature of the terrain makes the Marines bunch together too closely for tactical comfort but ready for any attack.*

USA

# M29C Weasel

In 1943 plans were made to invade German-held Norway, and it was appreciated that some form of snow-crossing cargo carrier would be required. After a series of trials a tracked vehicle known as the **T15 Weasel** was selected for service and this was later developed into the **T24**, still named Weasel and developed for use not only over snow but over mud, rough terrain and swamps. In time the T24 was standardized as the **M29 Cargo Carrier** and from this evolved the **M29C** amphibious light cargo carrier. The name Weasel was once more carried over, even though the official name **Ark** was promulgated.

The M29C was a simple conversion of the land-use M29. Changes were made to the flexible rubber tracks to enable them to provide propulsion in water, flotation chambers were provided at front and rear, and twin rudders were added for steering in water. The land M29 had already demonstrated its abilities to cross just about any type of terrain, including snow and rough stony ground, and the M29C retained all these qualities. In water it was somewhat slow and it could not operate in other than inland waterway conditions, so its use in surf or rough water was very limited. But when used correctly the M29C soon proved to be a valuable vehicle. Its uses were legion, especially during the many island-hopping campaigns in the Pacific theatre. Once ashore they were used to cross terrain that no other vehicle could attempt, and they carried men, supplies and even towed artillery using their rear-mounted towing pintle. Rice fields were no obstacle and the M29C was equally at home crossing sand dunes.

The M29C and the land-based M29 Weasels were used as ambulances on many occasions. Another use was for crossing minefields as the Weasel's ground pressure was very low, often too low to set off anti-tank mines. A technique was even evolved whereby the Weasels could be controlled remotely using hand-operated cords, but this technique had its limitations. The Weasels were also very reliable: they rarely broke down and their track life was later found to be far in excess of anticipations.

The M29C was also used by signal units, for its ability to cross water and land impassable to other vehicles made it a very valuable wirelaying vehicle. But it was as a supply or personnel carrier that it was most useful. Although unarmoured, M29Cs were often used to carry armed troops across water obstacles and land them in front of an enemy position, other M29Cs then following up with ammunition and supplies.

By the time the war ended about 8,000 M29C Weasels had been produced, and orders for a further 10,000 were then cancelled. But the M29C concept had been well established by then and since 1945 many follow-on designs have been produced.

M29Cs were used by several of the Allied armies. The British army made use of a number during 1944 and 1945 and for a few years after that. Some European armies used them for years after the war, and numbers can still be found in civilian hands, hard at work over swampy terrain.

## Specification
**M29C**
**Crew:** 1+3
**Weights:** unloaded 2195 kg (4,840 lb); loaded 2740 kg (6,040 lb); payload 390 kg (860 lb)
**Powerplant:** one Studebaker Model 6-170 petrol engine developing 55.9 kW (75 bhp)
**Dimensions:** length overall 4.794 m (15 ft 8.75 in); length over hull 4.4 m (14 ft 5.5 in); width 1.7 m (5 ft 7 in); height 1.797 m (5 ft 10.75 in)
**Performance:** maximum road speed 58.58 km/h (36.4 mph); maximum water speed about 6.4 km/h (4 mph)
**Armament:** none

*American personnel undergo a rather bumpy ride in an M29C Weasel over swampy terrain. The rear-mounted rudders can be clearly seen, and these were lowered once the vehicle actually entered the water.*

*The M29C Studebaker Weasel was used as an amphibious cargo carrier, but could be used to carry personnel. Although small, it could carry useful loads over almost any type of terrain, and once in the water used its tracks to provide propulsion at slow but steady speed.*

JAPAN

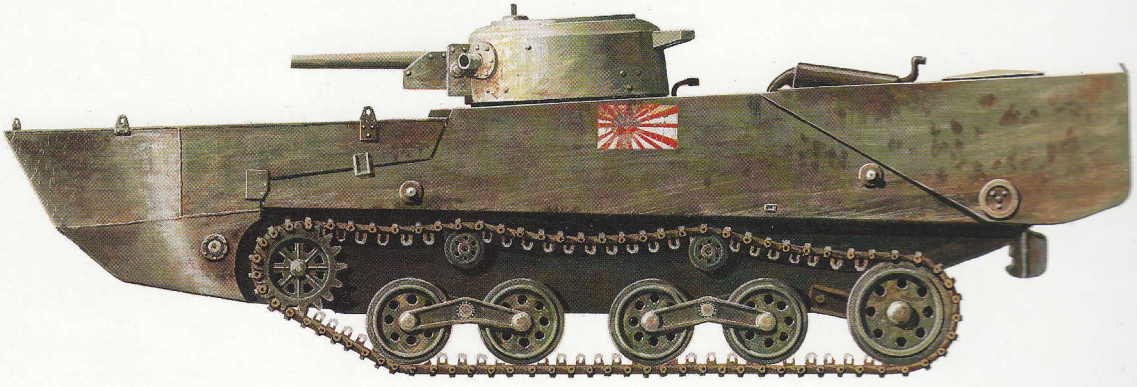
# Type 2 Ka-Mi

The Japanese army produced an amphibious halftrack as early as 1930, and tested it extensively before deciding that it was too underpowered for full cross-country mobility and thus turning to other projects. However, the idea of an amphibious armoured vehicle of some kind was not entirely lost and some low-priority experimentation went on throughout the 1930s in an attempt to produce an amphibious vehicle for the Japanese navy. One of these projects was to add kapok-filled floats to a Type 95 Kyu-Go light tank, the tank/float combination being propelled by two outboard motors. The idea was to produce a tank-landing or river-crossing system only, but although the floats worked the combination was very difficult to steer and the project was abandoned at the trials stage.

But the idea of making the Type 95 Kyu-Go into an amphibious light tank did not disappear. Instead of the float devices it was decided to redesign the hull of the Type 95 and use steel pontoons fore and aft to provide buoyancy. The wheels, track, suspension and engine (along with many other components of the Type 95) were retained, but the hull became a larger and bulkier shape. Large slabs of armour plate were used on the hull, which had inbuilt buoyancy chambers, and a redesigned turret carried a 37-mm anti-tank gun with a co-axial 7.7-mm (0.303-in) machine-gun. Special-to-role extras included a bilge pump, and drain holes were inserted into the road wheels. In the water the two steel pontoons were held in place by securing clamps, and once ashore the pontoons were discarded. Steering was effected by rudders on the rear pontoon, controlled by cables from a steering wheel in the turret. As there was very little freeboard when floating a trunking arrangement was usually erected around the engine intake grills on the hull top.

The amphibious light tank was designated the **Amphibious Tank Type 2 Ka-Mi** and it went into production during 1942. Compared with the land-based light tanks it had several innovations, not the least of which was radio

*The Type 2 Ka-Mi amphibious light tank was the most commonly-used of the Japanese swimming tanks. It had pontoon floats fore and aft to give most of the swimming buoyancy, and the bulky hull also had large buoyancy chambers to provide even more flotation once in the water.*



and a telephone intercom system for all crew members. Compared with land-based tanks, the Type 2 also had an increase in crew numbers: the Type 95 Kyu-Go had a crew of only three, but the Type 2 could house five, mainly as a result of the increased internal volume of the hull. One of this increased crew was a mechanic who looked after the engine and the power transfer from the road wheels to the two propellers that drove the vehicle in water.

For its period the Type 2 Ka-Mi was a successful little amphibian, and was used operationally on several occasions by the Japanese navy. However, it suffered the fate of most Japanese armour, being used in dribs and drabs to provide purely local infantry support. By 1944 they were more often than not used simply as land-based pillboxes in attempts to defend islands against invasion, which was a waste of their amphibious potential. Their other problem was that there were never enough of them. Japanese industry could never produce enough to meet demands, and as every vehicle was virtually hand-built production was always slow. But for all that the Type 2 Ka-Mi was one of the best designs of its period.

*This Type 2 Ka-Mi light amphibious tank has its forward pontoon float detached and resting on the ground, clearly showing the large size of this component. The truck is a 2-ton Nissan 180 cargo vehicle produced during the latter stages of the war in the Pacific.*

### Specification
**Type 2 Ka-Mi**
**Crew:** 5
**Weights:** with pontoons 11301 kg (24,914 lb); without pontoons 9571 kg (21,100 lb)
**Powerplant:** one 6-cylinder air-cooled diesel developing 82 kW (110 hp)
**Dimensions:** length with pontoons 7.417 m (24 ft 4 in); length without pontoons 4.826 m (15 ft 10 in); width 2.79 m (9 ft 1.8 in); height 2.337 m (7 ft 8 in)
**Performance:** maximum land speed 37 km/h (23 mph); maximum water speed 9.65 km/h (6 mph); land radius 199.5 km (125 miles); water radius 149.6 km (93 miles)
**Armament:** one 37-mm gun and two 7.7-mm (0.303-in) machine-guns

GERMANY

## Land-Wasser-Schlepper

In 1936 the German army general staff called upon Rheinmetall Borsig AG to develop a special tractor that could be used in amphibious operations. The idea was that the tractor could tow behind it a special trailer that could also float, capable of carrying vehicles or other cargo up to a weight of about 18000 kg (39,683 lb). Afloat the tractor would act as a tug for the floating trailer, but once ashore the tractor would have to pull the trailer to a point where it could be safely unloaded.

Rheinmetall undertook the project and produced the **Land-Wasser-Schlepper** (land-water tractor) or **LWS**. The LWS was very basically a motor tug fitted with tracks and was a large and awkward-looking machine that nevertheless turned out to be a remarkably workmanlike vehicle. The LWS had a flat bottom on each side of which were two long sets of tracks. On each side four sets of road wheels were suspended in pairs from leaf-spring suspensions. The LWS had a pronounced bow and on top was a cabin for the crew of three men and space for a further 20. What appeared to be a small funnel was in fact an air intake for the engine. At the rear, or stern, two large propellers were placed for water propulsion. To round off the nautical flavour of the LWS the sides of the crew cabin had portholes.

In contrast the floating trailer was a large slab-sided affair that, on land, moved on wheels located on one axle forward and two at the rear. At the rear a ramp could be folded down for loading, a typical load being an SdKfz 9 18-tonne halftrack whose crew transferred to the LWS for the water journey.

The LWS and trailer concept was conducted through a series of trials with no great sense of urgency until the aftermath of May and June 1940 brought the prospect of 'Seelöwe' (Operation 'Sea Lion', the invasion of the UK) to the forefront. The LWS and trailer could no doubt have been used for such an operation but it was really intended for the calmer waters of inland water obstacles. Even so the LWS was pushed with a greater sense of urgency for a while, but the project never really got off the ground and by 1941 it had been abandoned.

One point that counted against the LWS was that it was unarmoured, and it was felt that armour would be needed for any operations likely to be undertaken. It was also felt that the floating trailer was a bit cumbersome so a new idea was taken up. The overall layout of the LWS was retained, but this time the trackwork and suspension of a PzKpfw IV tank was used to carry a lightly armoured floating chassis. Two of these vehicles, known as **Panzerfähre** or **PzF**, were supposed to carry a large pontoon between them with the tank or other load on it. Thus the PzF would have been a ferry rather than a tractor, but the whole project was abandoned during 1942 after two prototypes had been built and tested.

After 1945 the LWS was captured in Germany and brought to the UK for a thorough technical evaluation by the British.

*The German LWS was built to carry up to 20 men and a crew of 3, and it could also tow a floating trailer carrying a vehicle or some form of weapon.*

### Specification
**LWS**
**Crew:** 3+20
**Weight:** 13000 kg (28,660 lb)
**Powerplant:** one Maybach HL 120 TRM V-12 engine developing 197.6 kW (265 hp)
**Dimensions:** length 8.60 m (28 ft 2.6 in); width 3.16 m (10 ft 4.4 in); height 3.13 m (10 ft 3.3 in)
**Performance:** maximum road speed 40 km/h (24.85 mph); maximum water speed unloaded 12.5 km/h (7.8 mph); road range 240 km (149 miles)
**Armament:** none

# The Battle of Tarawa

*The amphibious assault on Tarawa was one of the toughest of the whole Pacific campaign. The US Marines had to cover 15 km (10 miles) before they reached the shore, crossing enemy obstacles and the coral reef under heavy Japanese shelling, which continued despite a bombardment by US battleships and series of air strikes. The water inshore of the reef was very shallow, grounding many of the landing craft, but the amphibians pressed on to the beach under a hail of fire.*

Tarawa lies some 4025 km (2,500 miles) south west of Pearl Harbor, and its strategic importance in 1943 rested upon its geographical position along the route from the Allied-held New Hebrides to the main Japanese south east Pacific bastion at Truk, plus also the fact that on Tarawa the Japanese had built an airstrip capable of taking fighters and light bombers. By the same token, the Japanese had built heavily concreted defence positions in a network of underground casemates around the strip and manned them with some 2,600 well-trained troops, augmented by another 2,000 Korean construction workers who could be trusted to assist in the island's defence.

Tarawa consists of a submerged coral reef in the rough shape of an archer's bow, with several stretches of the reef rising above the waves to form islets upon which palm and scrub vegetation has taken root over the centuries. The bow encloses a lagoon into which there is only one channel, near the apex of the bow, and the nearest islet to the channel is Betio, barely 4.8 km (3 miles) long and less than 0.8 km (0.5 mile) wide, upon which the airstrip and the bulk of the Japanese defences lay. Betio, obviously, was the prime target for Allied assault.

From the point of view of the commanders of the assault force, Rear-Admiral Harry Hill and Major-General Julian Smith commanding the 2nd Marine Division, the greatest initial problem would be to get the men ashore and then supply them across a coral reef which gave at most 1.06-m (3.5-ft) draught, and ran across an attack front varying between 550 and 915 m (600 to 1,000 yards) from the target beaches. The LCVPs which would normally be used (and in any case would still have to carry the bulk of the supplies) might just scrape across the reef if they were not too heavily laden, but the LCMs carrying vehicles and (as soon as possible after the assault) light tanks would have no chance at all of going all the way in.

## LVTs for the Marines

The only vessels available in the Pacific at the end of 1943 which might be able to save the US Marines a long and exposed walk through waist-deep water towards a defended beach, were LVTs (Landing Vehicles Tracked), used so far only to take supplies into an established beach-head, and either totally unarmoured or in the case of some 50 LVT 2s, very lightly armoured and fitted with only two machine-guns (one 7.62-mm/0.3-in and one 12.7-mm/0.5-in). Some rehearsals were carried out with those vehicles available, boiler-plate was fitted to the sides and cab-fronts of some LVT 1s, and it was piously hoped that covering fire would compensate for the lack of armoured protection.

As the Japanese commander, Rear-Admiral Shibasaki, had not surprisingly placed his heavy armament and main defences to face out to sea, the American commanders decided to put the US Marines ashore inside the lagoon. Even here, though, aerial reconnaissance reported that the defences were strong: underwater booby-trapped obstacles littered the lagoon bed, and a 1.2-m (4-ft) high sea-wall of coconut logs at the top of the beaches which might have offered some shelter was obviously enfiladed by well-sited machine-gun posts.

*Marines take cover from fire from a Japanese bunker and watch as a special assault team attempts to burn out the defenders. Tarawa was covered by so many bunkers that progress across the island was slow and difficult, with each enemy strongpoint having to be taken in turn.*

Admiral Shibasaki's boast that the Americans could not take Betio with one million men in 100 years did not at first glance seem totally unfounded.

*This aerial view of one of the Tarawa landing beaches demonstrates how the nature of the sea wall and the blasted terrain prevented many of the LVTs from making their way inland.*

# The Battle of Tarawa

On 13 November 1943 Task Force 52 left Efate in the New Hebrides, overtook on 17 November the slower-moving LST group carrying the LVT 2s and arrived some 9.7 km (6 miles) off the outer beaches of Betio in the early hours of 20 November. The guns of the flagship, the USS *Maryland*, two other battleships and six cruisers were soon engaged in a duel with the Japanese coastal armament, while the marines of the assault combat teams from 2nd and 8th Marine Regiments clambered down the heavy debarkation nets; the first wave went straight into the LVTs, the second and third waves into LCVPs, and the fourth wave into sea boats already loading with heavy weapons and equipment. Led by minesweepers and escorted by two destroyers, the lines of landing craft made for the narrow channel through the reef, and as dawn lightened the sky they threaded their way into the lagoon and began the turn for the run-in.

## Strafing raids

As they did so carrierborne aircraft streaked in from the west and for nearly half an hour strafed the length of the island, especially the runways and any sign of habitation or strongpoint the pilots could see. As the aircraft screamed away into the growing light, the heavy naval guns at sea opened up in a concentrated bombardment which shrouded Betio in smoke and huge billowing clouds of coral dust, effectively blinding both the defenders and, more critically, the drivers of the manouvring LVTs, all keenly aware of the necessity of putting their passengers down on the right beaches.

*A Navy F6F Hellcat roars in to blast inland Japanese positions as Marines take cover behind the sea wall of Tarawa and stranded LVTs litter the background. Getting over this was was one of the Marines' most difficult tasks in the initial landing operations.*

*Bodies of Japanese troops lie amongst the wreckage of a bunker on Tarawa in the aftermath of three days of desperate fighting. Of the Japanese garrison, 4,690 were killed and 17 wounded soldiers were captured. The body count at Tarawa was testimony to the bravery of the Japanese and an ominous sign for the Marines.*

There were three of these (Red 1, 2 and 3), each the goal of a reinforced battalion, but the first marines to go ashore were a scouting sniper team under Lieutenant Hawkins, whose task it was to storm the end of a long pier which separated Red 2 and 3, neutralize its defences and hold the pier for use by the supply vessels as they came in. The team's LCVP hit the reef at the end of the pier on time and Hawkins led his men up the ramp conveniently built there by the defenders, to find himself immediately engaged in a swift and violent action among stacked fuel drums, two of which exploded during the fight. Two wooden huts were attacked with a flamethrower (and the resulting conflagration burned through an area of the pier floor, thus adding later to the problems of the supply teams), a dozen Japanese soldiers were killed and then the pier was in American hands. By this time the first LVTs had clambered across the reef and were swimming in towards the beaches. Some were hit during that last approach, machine-gun fire laced the air across the width of all the beach-heads, but by 09.10 the first wave of marines was rolling over the sides of the craft and racing up towards the dubious shelter of the coconut palisade. Fortunately, fire from the escorting destroyers had already obliterated two of the enfilading machine-gun posts, and soon the others were also silenced. The marines dug in deeper, sniped at anything that moved inland, and waited for their supporting waves to arrive.

All along the reef edge the LCVPs and LCMs grounded; the water was even lower than ex-

pected and nothing untracked could cross. Grimly, the marines slid down into the water and began the awful walk to the beaches: there was nothing to hide behind, and the Americans were held down to a slow trudge through waist-high water, frothed by machine-gun crossfire and an inferno of explosions, only too often stained deep pink from the writhing bodies of their friends. But nothing stopped the survivors; as more and more craft arrived at the reef, so more and more lines of men filled the lagoon and waded implacably forward, and soon the lines were reaching the beaches and running up towards the palisade.

## Hidden Japanese

Here slow progress was made. The Japanese were largely unseen, except for flickering tongues of red and orange flame stabbing from gun-ports in low-lying and concealed bunkers. Every move put the attackers in a different firelane, and casualties mounted at a worrying rate. Colonel David Shoup, the combat commander, went ashore on Red 2 just before noon and his first signal back to Admiral Hill read 'Issue in doubt'. But first impressions in battle are apt to be uncertain, and shortly afterwards the first of the light tanks threaded their way through the swamp of floating bodies and moved quickly to the aid of the pinned-down infantry.

More waves came into the beach, the heavy supplies trundled along what remained of the pier and reached the men who needed them, and as the long afternoon dragged by and dusk fell, the initiative passed inevitably into the marines' hands and the Japanese lost any chance they had of driving their attackers off Betio. They made no attempt at a counterattack during that night (the bombardment had smashed their communication system) and the next morning (21 November) another battalion of the 8th Marines came ashore after a wretched night spent bobbing about in LCVPs.

Pack howitzers were now ashore, the destroyers became ever-more accurate in pinpointing their targets, two companies of marines broke clean through across the airstrip and reached the ocean shore where they dug in, and the whole of the western end of Betio came under American control, allowing yet more marine battalions to land. The situation closely resembled that on Crete in 1941 once Maleme airfield had fallen to the German paratroops: the attackers could be strengthened, and the defenders were being inexorably ground away.

## Counterattack

On the last day of the battle, the Japanese did mount a counterattack, some 500 men boiling up out of the underground casemates to throw themselves through devastating destroyer and artillery fire at a marine company, and in 20 minutes of chaos and confusion at bayonet and grenade range, both sides were almost annihilated. But there were more Americans than Japanese, so the result was pre-ordained. The following morning the 2nd Marine Division completed mopping up, destroying the last defenders in co-ordinated infantry/tank operations, and at 13.12 on 23 November General Smith declared Betio secured.

*A US Marine rises above his sandbagged position to hurl a hand grenade at a Japanese position. The Japanese had extensively fortified Tarawa and demanded a heavy price for every bunker: over 1,000 leathernecks were killed and 2,500 wounded.*

The Japanese and Korean defenders on the other islets of Tarawa atoll were quickly overcome, though in the case of the Japanese soldiers each one had to be cornered and killed; only 17 wounded Japanese were taken alive, most of the 146 PoWs being Korean. The remainder of the 4,750-strong garrison fought to the death. On the other side, over 1,000 US Marines had been killed and more than 2,000 wounded.

Four Medals of Honor were won on Tarawa, the fame of the US 2nd Marine Division established for ever. And lessons were learned in the science of amphibious warfare which would save countless lives in future months.

*The aftermath of the initial stages of the Tarawa landings: wrecked and stranded LVTs litter the sea wall. Underwater obstacles and enemy fire combined to make this opening phase of the Tarawa landing one of the most costly of the many amphibious operations in the Pacific.*

GERMANY

# Schwimmwagen

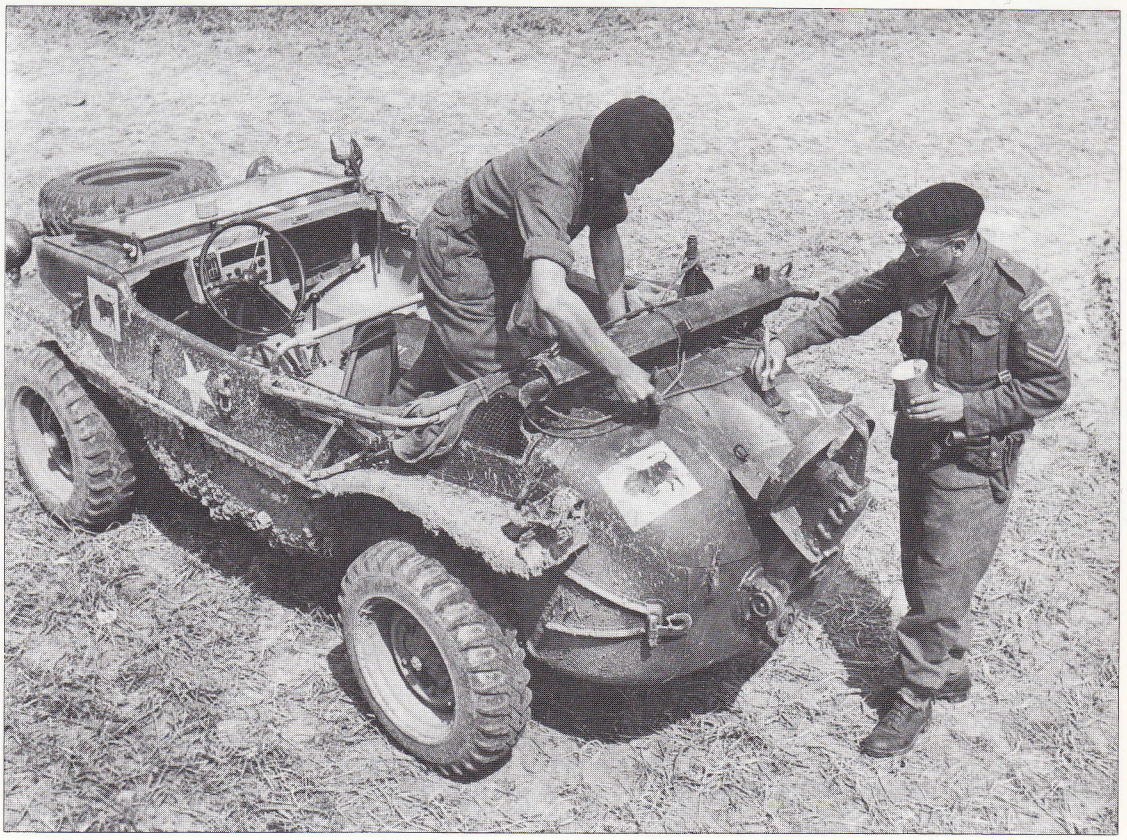
The term **Schwimmwagen** that is usually applied to the amphibious version of the military Volkswagen was not strictly correct, for the term merely means amphibious vehicle. The correct designation was **Schwimmfahiger Gelandeng Typ 166**, though the vehicle was usually just called the Schwimmwagen. It was originally developed during 1940 for use by airborne troops, and was supposed to have a good cross-country performance coupled with an amphibious capability. It was designed to make as much use of existing Kübelwagen (the military version of the Volkswagen) components as possible. In the end most of those built were used mainly on the Eastern Front, and the production reached a total of 14,625.

The Schwimmwagen was used to supplement the various types of motorcycle/sidecar combinations used by reconnaissance and other units. It was a small, sturdy little vehicle with a rather bulky body to provide flotation, and with a propeller at the rear for water propulsion. It could seat four men at a squeeze, especially if they carried all their equipment, for internal space was rather limited. The production line was at the Volkswagen plant at Wolfsburg, and it was often disrupted by Allied bombing raids before the line was closed during 1944, mainly as a result of raw material shortages.

But the German army demanded more and more of these vehicles during the early war years, for the Schwimmwagen was a handy little machine. Apart from its reconnaissance role, many were used by commanders of all types of unit who found them very useful for visiting scattered units, especially over the wide expanses of the Eastern Front. The vehicle was powered by a 1.3-litre petrol engine that was slightly more powerful than that of the Kübelwagen and which gave the Schwimmwagen a better all-round performance. To make sure that none of the cross-country power was lost special all-terrain tyres were fitted.

The propeller used to drive the vehicle in water was located on a swinging arm at the rear. Before the vehicle entered the water this arm had to be lowered to align the screw with the drive chain, and once propeller drive had been selected the rest of the transmission was isolated. Water steering was effected via the front wheels. Despite its handiness in water the Schwimmwagen proved to be equally at home in the desert wastes of North Africa, some ending in that theatre with the Deutsches Afrika Korps. Rommel made requests for more, but instead the bulk of the production went to the Eastern Front where the air-cooled engine and the presence of more water obstacles meant it could be used to better effect; Rommel instead got Kübelwagens. Many of the Eastern Front models were fitted with a special tank containing a very volatile fuel for starting under winter conditions.

The Schwimmwagen was an attractive little vehicle and many were used by the Allies, often as trophies but more usually for run-abouts by Allied commanders. Many still exist as collector's items.



*British troops maintain a captured German Schwimmwagen that has been pressed into Allied use as a runabout. They are working on the propeller unit that was lowered as the vehicle moved into the water. Note the overall chubby appearance of the design, produced by the use of flotation chambers.*

*Waffen SS soldiers from one of the SS Balkan units are about to board their Schwimmwagen during operations against partisans. During such operations the amphibious qualities of this vehicle could often be used to good advantage, as water obstacles were no problem.*

## Specification

**Schwimmfahiger Gelandeng Typ 166**
**Crew:** 1+3
**Weights:** unloaded 903.5 kg (1,992 lb); payload 434.5 kg (958 lb)
**Powerplant:** one VW 1.13 litre petrol engine developing 18.64 kW (25 hp)
**Dimensions:** length 3.825 m (12 ft 6.6 in); width 1.48 m (4 ft 10.3 in); height 1.615 m (5 ft 3.6 in)
**Performance:** maximum road speed 80 km/h (50 mph); maximum water speed 11 km/h (7 mph); range 400-450 km (250-280 miles)
**Armament:** none

Armed Forces of the World

# China Part 2

## The Chinese Navy

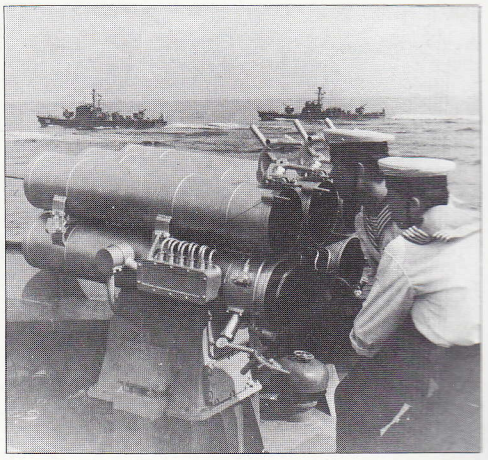
The navy of the People's Republic of China has a current strength of 284,000 regular officers and men, with an additional 40,000 in the naval air arm and 38,000 in the marine corps. The reserves add at least another 200,000 to these figures. The navy is subdivided into three fleet areas, the North Sea Fleet being the major one as it is nearest to the Soviet Pacific Fleet's main operating bases. The other two are the East Sea Fleet and the South Sea Fleet.

In terms of capabilities the navy is in fact a service of contrasts. On the one hand it has a growing fleet of sophisticated nuclear submarines indicating a high level of expertise in the nuclear sector, whilst on the other hand its current conventional submarine and surface combatant construction programmes reflect the country's lack of a technology base in the armament and electronics required for such vessels. To offset this problem the Chinese approached the US Navy, which sent as part of a recent Department of Defense delegation several high-ranking officers who apparently discussed the possibility of supplying 20-mm Phalanx CIWS, radars, sub-surface weapons and sensors to equip current and future naval construction. A previous attempt along similar lines by the British earlier in the 1980s was cancelled because of the high costs involved.

In 1981 the first Chinese 'Xia' class 8,000-ton, 120-m (393.7-ft) long SSBN was launched at the Huludao shipyard, 200 km (125 miles) north east of the capital, Beijing. Entering operational service in 1985, this vessel will be followed by at least another five craft of the same class. An indigenous two-stage solid-propellant SLBM, the CSS-N-3, has been designed and built for use in the 12 missile tubes fitted to each unit. Before turning to SSBNs in the early 1970s, the same shipyard launched the prototype of the Albacore-hulled 4,500-ton, 100-m (328.1-ft) long 'Han' class SSN. After a lengthy trials period this was followed by a second unit of the class in 1980, with another two to follow during the mid- to late-1980s. This small nuclear submarine force is backed by a large conventional submarine fleet of over 90 ex-Soviet and Chinese-built copies of the Soviet 'Romeo' design, two unsatisfactory indigenous 'Ming' class units, and 20 or so obsolete Chinese-constructed examples of the Soviet 'Whiskey' class. Although powerful in terms of overall numbers, these boats are severely limited in operational capability by their 1950s' and 1960s' technology weapons and systems. A new more modern conventional submarine class for series production is postulated for the mid-1980s, and it is believed that the prototypes are undergoing trials now.

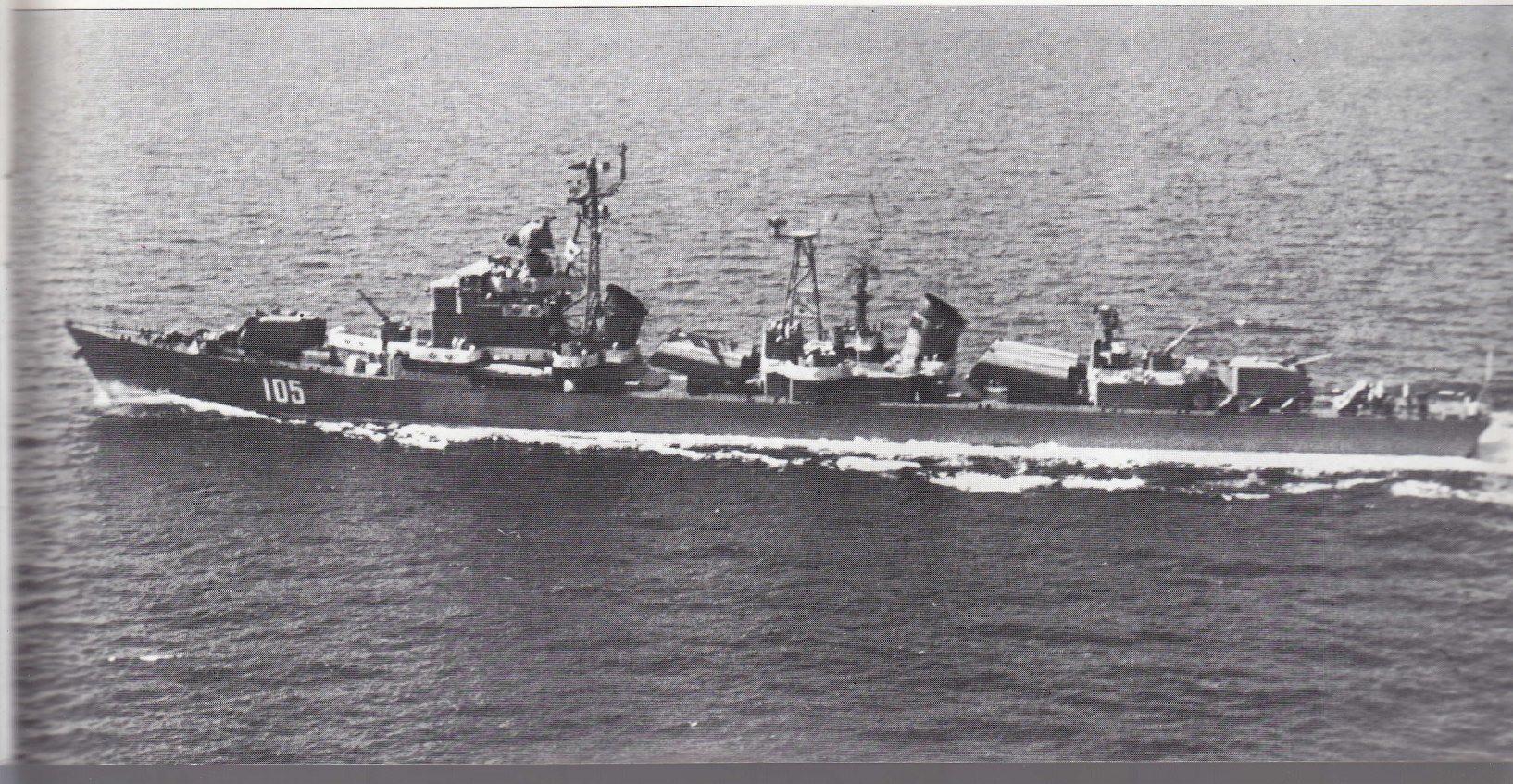
The largest surface warships in the navy are of destroyer size. These are four anti-ship cruise missile-armed 'Anshan' class vessels (although still in relatively good condition, these are in fact converted ex-Soviet World War II 'Type VII' class gun destroyers transferred to China in 1954-5 from the Soviet Pacific Fleet), and the indigenous 'Luda' design. The latter was begun in the early 1960s and appears to owe a lot to the Soviet 'Kotlin' destroyer design. The first unit was completed in 1971, and the construction programme is still under way. A total of around 16 is in service, and these are armed with anti-ship cruise missiles. The number would have been greater but for the interruption in the shipyards in the early 1970s caused by the coup attempt of the defence minister, Lin Biao.

To assist the destroyers in their work there is a growing number of frigates, most of which are of local design. The latest product is the 'Jianghu' class, of which some 15 are in service in three subclasses, the 'Jianghu I', 'Jianghu II' and 'Jianghu III'. A final class total of over 20 is expected. The sole area SAM defence ships in the navy at present appear to be the two units of the 'Jiangdong' frigate class which, after a long building period, have only just become fully operational. It is probable that by now the navy has deployed large numbers of the locally built NH-5 'Red Tassel' shoulder-launched short-range defence SAM to supplement the ships' automatic AA guns. Apart from the 'Jianghus' there are also four Chinese-built Soviet 'Riga' class frigates (known locally as the 'Chengdu' class) as well as a further five units of a 'Riga' variant known as the 'Jiangnan' class. For second-line duties and coastal patrol the Chinese have retained in service a total of some 14 ex-Japanese, British, Australian and Nationalist Chinese World War II corvettes, which they have not only refitted but also rearmed with more modern weapons.



*The Chinese navy possesses a large force of fast attack craft to supplement its growing nuclear submarine fleet. Many of the Chinese surface vessels are now obsolescent and their equipment similarly dated. Here, Chinese sailors man an MBU 1800 250-mm anti-submarine mortar aboard a 'Shanghai II' class fast attack craft.*

*Mainstay of the Chinese surface fleet, the 'Luda' class destroyers are similar to the Soviet 'Kotlins'. Built in two batches, the 'Ludas' are armed with two triple launchers for SS-N-2 type 'Hai Ying' missiles, a pair of FQF 2500 anti-submarine rocket launchers and four 130-mm guns, and can make a maximum speed of 36 kts.*



*'Shanghai II' fast attack craft carry two 37-mm and two 25-mm gun positions: (left) twin 37-mm L/63s, a Soviet weapon first introduced in 1943; and (right) twin 25-mm L/80s. The 300 'Shanghai IIs' also have eight depth charges and can make 30 kts.*

The real strength of the navy, however, lies in its light forces. These comprise some 220 fast attack craft (missile) based on the Soviet 'Komar' and 'Osa' designs and armed with the locally-built version of the Soviet SS-N-2 'Styx' anti-ship cruise missile, 340 fast attack craft (gun), and 250 fast attack craft (torpedo). In addition there are also some 60 large patrol vessels fitted for coastal ASW duties, and 140-150 smaller coastal and river patrol craft.

Unfortunately there are only 23 'T43' class ocean minesweepers with 100 coastal and auxiliary units to counter the major Soviet threat in this area. Offensive minelaying is reliant mainly on the submarine force and the larger surface vessels, together with the bombers of the naval air arm. Defensive laying can be undertaken by most naval warship classes, but is dependent on stocks of mainly ex-Soviet World War II mine types that have been copied.

The amphibious warfare force comprises a mix of both old and new craft, and can comfortably lift a complete division of the People's Army together with all its equipment over medium distances. The marine corps is now getting a growing number of hovercraft for assault and logistics work, and this shows a greater awareness of the hovercraft's potential than is apparent in some Western navies.

For extended periods at sea the navy now has a limited number of underway replenishment ships fitted with equipment similar to the American liquid and solid store transfer systems. More development in this area is expected as the navy conducts longer deployments into areas such as the Indian Ocean.

The Aviation of the People's Navy, as the naval air arm is titled, is predominantly shore-based although several of its French Aérospatiale SA321 Super Frelon transport helicopters have been pictured at sea on replenishment and research vessels. It is organized into three bomber and six fighter divisions, each with three regiments (that at maximum strength each comprise three squadrons of three flights of four or five aircraft, a maintenance unit and several light transports and trainers). The bomber divisions use a small number of Hong-6 (Tupolev Tu-16 'Badger') medium jet bombers for long-range reconnaissance, minelaying and anti-shipping strike with two underwing missiles based on the Chinese copy of the 'Styx'; Hong-5 (Ilyushin Il-28 'Beagle') torpedo attack, light bomber and photo-reconnaissance aircraft; Qiang-5 'Fantan-A' fighter-bombers for amphibious assault support; and a number of obsolete ex-Soviet Tupolev Tu-2 'Bat' piston-engine medium bombers for general bombing and minelaying training duties. The fighter divisions are integrated into the national air-defence network and are equipped with the locally-built F-7 (Mikoyan-Gurevich MiG-21), F-6 (MiG-19), F-5 (MiG-17) and F-2 (MiG 15) fighters. To supplement the fighters there are a limited number of SAM regiments equipped with the CSA-1 copy of the Soviet SAM-2 'Guideline' missile.

For ASW and medium-range maritime patrol there is an ageing force of ex-Soviet navy Beriev Be-6 'Madge' flying-boats armed with bombs and depth charges. There is no helicopter ASW force at present, although the navy flies a number of Mil Mi-1 'Hare', locally built H-5 (Mil Mi-4 'Hound') and the previously mentioned Super Frelon helicopters in the transport and communications roles. For freighting there are the Y-5 Chinese version of the Antonov An-2 'Colt' light transport and a number of Lisunov Li-2 (Soviet-built Douglas C-47) medium transports.

Although precise details of the navy are not available, the following order of battle is believed to be reasonably accurate.

## Chinese Navy order of battle

SSBNs: one 'Xia' class and five more building
SSNs: two 'Han' class and two more building
submarines: two 'Ming', 20 'Whiskey' and 93 'Romeo' class, plus more 'Romeo' class units building
missile destroyers: four 'Anshan' class and 15 'Luda' class, plus more 'Luda' class units building
missile frigates: two 'Jiangdong' class, four 'Chengdu' class and 16 'Jianghu I', 'Jianghu II' and 'Jianghu III' classes, with more 'Jianghu' class units building
frigates: five 'Jiangnan' class
escorts: 14 assorted World War II types
fast attack craft (missile): 120 'Osa' and 100 'Komar' types
fast attack craft (gun): 300 'Shanghai II' and 'Shanghai III' classes, 40 'Shantou' class and three 'Haikou' class
fast attack craft (torpedo): 140 'Huchuan I' and 'Huchuan II' classes, 60 'P6' class and 50 'P4' class
large patrol craft: 40 'Hainan' class and 20 'Kronshtadt' class
coastal and river patrol craft: four 'Taishan' class, 30 'Beihai' and 'Wuhsi' classes, 30 'Fujian' class, 40 'Huangpu' class, 40 'Yulin' class and two 'Yingkou' class
MCM vessels: 23 'T43' class, 20 'Fushun' class and 80 auxiliary sweepers
amphibious warfare vessels: 23 or more LSTs, 47 or more LSMs, 350 or more LCUs, 160 or more LCMs, some 20 hovercraft, with more of all types building

## Chinese Naval Air Arm order of battle

bombers: 50 B-6, 50 Tu-2, 50 B-5 (including reconnaissance variant), and 150 B-5 torpedo bombers
fighters: 50 J-7, 300 J-6, 200 J-5 and 80 J-2
attack: 50 Q-5
ASW: 20 Be-6
helicopters: 40 H-5, 20 Mil-1 and 13 Super Frelon
transports: 20 Li-2 and 40 Y-5